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Pre-Design Studies Field
Sampling and Quality
Assurance Plan

Operable Unit 1 North Bronson
Industrial Area Site

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| | |
|--|------------|
| B1. Introduction | 1-1 |
| B2. Project Description | 2-1 |
| B2.1 Site Description | 2-1 |
| B2.2 Project Objectives And Scope | 2-1 |
| B2.3 Sample Network Design And Rationale | 2-3 |
| B2.4 Parameters To Be Tested And Frequency | 2-3 |
| B2.5 Data Quality Objectives | 2-3 |
| B2.6 Project Schedule | 2-4 |
| B3. Project Organization And Responsibility | 3-1 |
| B3.1 ARCADIS Geraghty & Miller Project Coordinator | 3-1 |
| B3.2 ARCADIS Geraghty & Miller Project Manager | 3-1 |
| B3.3 Technical Staff | 3-1 |
| B3.3.1 Field Team Leader | 3-2 |
| B3.3.2 Data Reviewer | 3-2 |
| B3.3.3 Engineering Evaluation Leader | 3-2 |
| B3.4 STL Quanterra Management | 3-2 |
| B3.4.1 Laboratory Operations Manager | 3-2 |
| B3.4.2 Laboratory Quality Assurance Officer | 3-3 |
| B3.4.3 Laboratory Sample Custodian | 3-3 |
| B4. Quality Assurance Objectives For Data Measurement | 4-1 |
| B4.1 Quality Control (QC) Samples | 4-1 |
| B4.2 Accuracy, Precision and Sensitivity of Analysis | 4-2 |
| B4.3 Completeness, Representativeness and Comparability | 4-3 |
| B5. Sampling Procedure Plan (SPP) | 5-1 |
| B5.1 Introduction | 5-1 |

| | | |
|------------|--|------------|
| B5.2 | Sample Designation | 5-3 |
| B5.3 | Field Procedures | 5-4 |
| B5.3.1 | Completion of Soil Borings for Soil Sampling and Well Installation | 5-4 |
| B5.3.2 | Collection of Subsurface Soil Samples for Laboratory Analyses | 5-6 |
| B5.3.3 | Collection of Sediment Samples for Laboratory Analysis | 5-7 |
| B5.3.4 | Installation and Development of Monitoring Wells | 5-8 |
| B5.3.5 | Staff Gauge Installation | 5-10 |
| B5.3.6 | Abandonment of Galvanized Monitoring Wells | 5-11 |
| B5.3.7 | Collection of Groundwater Level Measurements | 5-11 |
| B5.3.8 | Groundwater Sampling and Laboratory Analyses | 5-12 |
| B5.3.9 | In-situ Hydraulic Conductivity Tests | 5-14 |
| B5.3.10 | Decontamination Procedures | 5-17 |
| B5.4 | Disposal Of Investigation-Derived Materials | 5-18 |
| B5.5 | Documentation | 5-19 |
| B6. | Sample Custody | 6-1 |
| B6.1 | Field Chain-Of-Custody Procedures | 6-1 |
| B6.1.1 | Field Procedures | 6-1 |
| B6.1.2 | Field Logbooks/Documentation | 6-2 |
| B6.1.3 | Transfer of Custody and Shipment Procedures | 6-3 |
| B6.2 | Laboratory Chain-Of-Custody Procedures | 6-4 |
| B7. | Calibration Procedures And Frequency | 7-1 |
| B7.1 | Field Instruments/Equipment | 7-1 |
| B7.2 | Laboratory Instruments | 7-2 |
| B8. | Analytical Procedures | 8-1 |
| B8.1 | Laboratory Analysis | 8-1 |

| | | |
|-------------|--|-------------|
| B8.2 | Field Screening Analytical Protocols | 8-1 |
| B8.3 | Laboratory Procedures | 8-2 |
| B9. | Internal Quality Control Checks | 9-1 |
| B9.1 | Field Sample Collection | 9-1 |
| B9.2 | Field Measurements | 9-1 |
| B9.3 | Laboratory Analysis | 9-1 |
| B9.4 | QA/QC Program | 9-1 |
| B9.5 | Quality Control Checks | 9-2 |
| B10. | Data Reduction, Assessment, And Reporting | 10-1 |
| B10.1 | Field Measurements And Sample Collection | 10-1 |
| B10.2 | Laboratory Services | 10-1 |
| B11. | Performance and System Audits | 11-1 |
| B11.1 | Field Audits | 11-1 |
| B11.2 | Laboratory Audits | 11-1 |
| B12. | Preventative Maintenance Procedures | 12-1 |
| B12.1 | Field Equipment And Instruments | 12-1 |
| B12.2 | Laboratory Instruments | 12-1 |
| B13. | Data Precision And Accuracy Procedures | 13-1 |
| B13.1 | Field Measurements | 13-1 |
| B13.2 | Laboratory Data | 13-1 |
| B13.2.1 | Precision | 13-1 |
| B13.2.2 | Accuracy | 13-2 |
| B13.2.3 | Sensitivity | 13-2 |
| B14. | Corrective Actions | 14-1 |
| B14.1 | Sample Collection/Field Measurements | 14-1 |

Appendix B

Pre-Design Studies Field Sampling
and Quality Assurance Plan (FSQAP)

Appendix B
Pre-Design Studies Field
Sampling and Quality
Assurance Plan

Operable Unit 1 North Bronson
Industrial Area Site

PREPARED FOR

North Bronson PRP Group

| | | |
|-------|---------------------|------|
| B14.2 | Laboratory Analyses | 14-3 |
|-------|---------------------|------|

| | | |
|-------------|--|-------------|
| B15. | Quality Assurance Reports To Management | 15-1 |
|-------------|--|-------------|

Tables

| | |
|------|--|
| B2-1 | Summary of the Laboratory Sampling and Analysis Program, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan. |
| B2-2 | Analytical Parameters, Analytical Methods and Practical Quantitation Limits, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan. |
| B2-3 | Summary of Field Measurement Program, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan. |
| B5-1 | Summary of Sample Container Requirements, Preservatives and Holding Times, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan. |

Figure

| | |
|-------|---|
| B3-1. | Project Organization Chart, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan. |
|-------|---|

Attachments

| | |
|---|---|
| A | Equipment Standard Operating Procedures (SOPs). |
| B | Equipment Decontamination Procedures. |
| C | Sample Core Log. |
| D | Monitoring Well Construction Detail. |
| E | Water Sampling Log. |

B1. Introduction

This document is the Pre-Design Studies Field Sampling and Quality Assurance Plan (FSQAP) for Operable Unit 1 (OU 1) at the North Bronson Industrial Area Site located in Bronson, Michigan (Site). This FSQAP presents the organization, objectives, functional activities, and specific Quality Assurance/Quality Control (QA/QC) activities associated with the Pre-Design Studies to be completed for the soil/sludge, sediment and groundwater data collection requirements set forth in the Record of Decision (ROD) for the Site (USEPA, 1998). Specific protocols are presented that will be followed for sampling, sample handling and storage, chain of custody, and laboratory analysis.

QA/QC procedures will be in accordance with applicable professional technical standards, United States Environmental Protection Agency (USEPA) requirements, Michigan Department of Environmental Quality (MDEQ) requirements, government regulations and guidelines, and specific project goals and requirements. This FSQAP was prepared by ARCADIS Geraghty & Miller, Inc. in substantial accordance with the USEPA Guidance Document entitled "EPA Requirements for Quality Assurance Project Plans, "EPA QA/R-5, interim final, dated November 1999.

The following sections describe the pre-design field activities scope and objectives, project organization, QA objectives, sample custody, various laboratory procedures and responsibilities, and corrective actions. Section 5 is the Sampling Procedures Plan (SPP).

B2. Project Description

This section describes the scope of work and project objectives for the pre-design activities to be performed at the Site.

B2.1 Site Description

A discussion of the Site geologic and hydrogeologic setting is provided in Appendix A of the Pre-Design Studies Work Plan (Work Plan). Figure 1-1 of the Work Plan shows the location of the Site.

B2.2 Project Objectives And Scope

The purpose of the pre-design studies is to collect the data necessary for completing the design of the selected remedy for OU-1. As stipulated in Section II, Item No. 7 of the Statement of Work (SOW), Appendix D to the Consent Decree *United States of America vs. Bronson Plating Company, et.al.*, entered February 29, 2000, the pre-design studies will include the following tasks:

- a) *Conduct groundwater sampling as necessary to establish current groundwater conditions and to provide data necessary to design the system. This groundwater monitoring program shall include the new monitoring wells described in paragraph 6.A of this SOW. Prior to collecting groundwater samples from existing monitoring wells, the wells shall be inspected to assess their integrity. Based on this integrity evaluation, Setting Defendants shall identify which wells, if any, should be abandoned or abandoned and replaced. Groundwater data collected during the pre-design studies will be assessed relative to the performance standards listed in Table 3 of the ROD to determine whether active groundwater remediation is warranted.*
- b) *Collect hydrogeologic data necessary to estimate groundwater flux into County Drain (CD) #30. This data shall then be used to estimate the target flow rate from a french drain that would be sufficient to capture groundwater that would otherwise discharge into CD #30.*
- c) *Estimate volume of accessible soils and sludges in the Eastern Lagoon area that exceed the soil and sludge cleanup goals listed in Table 1 of the ROD. Based on this volume estimate and the current groundwater*

conditions for the Eastern Lagoon Areas, the Settling Defendants may evaluate whether it would be more protective and cost-effective to excavate and dispose of the accessible soils and sludges from the Eastern Lagoon area, or to contain the soils and sludges in place by use of an engineered soil cover (and provisional groundwater recovery).

- d) Evaluate the technical feasibility of using the local Publicly Owned Treatment Works (POTW) to treat recovered groundwater from a french drain system that would be installed along the Western Lagoon area and, potentially, the Eastern Lagoon area. This pre-design studies task only needs to be conducted if the Settling Defendants decide to pursue direct discharge to the local POTW as a means for groundwater treatment instead of the wetland treatment system option.*
- e) Estimate quantity of sediments in County Drain #30 (CD #30) that exceed the sediment cleanup goals listed in Table 2 of the ROD.*
- f) Evaluate the potential use of a phyto-cover for the western lagoon area soil cover.*
- g) Identify data requirements for designing an engineered wetland treatment system and collect the necessary data. Evaluate whether a subsurface flow wetland treatment system or a surface flow wetland treatment system would be the most appropriate for the site.*
- h) Determine which existing and/or new monitoring wells shall be used as points of compliance wells.*
- i) Any additional studies needed to complete design as approved in the pre-design studies workplan.*

Note that Items a, b, c, e, and g listed above require the collection of field data. The collection of the field data will be governed by this FSQAP. The following field activities are planned for addressing Items a, b, c, e, and g above:

- Collection and analysis of subsurface soil/sludge samples at the Eastern Lagoons area.

- Installation of additional monitoring wells and monitoring well nests.
- Development of new monitoring wells and redevelopment of existing monitoring wells.
- Installation and monitoring of staff gauges in CD #30.
- Abandonment of existing galvanized steel monitoring wells.
- Collection of groundwater level measurements.
- Collection and analysis of groundwater samples.
- Conduct hydraulic conductivity tests in select new monitoring wells.
- Collection and analysis of sediment samples from CD #30.

B2.3 Sample Network Design And Rationale

The sample network design and rationale for sample locations (Figure 2-1 of the Work Plan) are described in detail in Section 2 of the Work Plan.

B2.4 Parameters To Be Tested And Frequency

Sample matrices, analytical parameters and frequencies of sample collection can be found in Table B2-1. The analytical parameters, analytical methods and laboratory detection limits for the Pre-Design Studies investigation are listed in Table B2-2. Field measurements to be collected and recorded are listed on Table B2-3.

B2.5 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during the project and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. There are five analytical levels that address various data uses and the QA/QC effort and methods required to achieve the desired level of quality. These levels are:

- Screening (DQO Level 1): This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to applicable or relevant and appropriate requirements (ARARs), initial site characterization to locate areas for subsequent and more accurate analyses, and engineering screening of alternatives (bench-scale tests). These types of data include those generated on-site through the use of a photoionization detector (PID), flame ionization (FID) or other field instrument.
- Field Analyses (DQO Level 2): This provides rapid results and better quality than in Level 1. This level may include mobile laboratory-generated data, depending on the level of quality control exercised.
- Engineering (DQO Level 3): This provides an intermediate level of data quality, suitable for engineering design purposes. All analyses are performed in a fixed-base (usually off-site) analytical laboratory. Level 3 laboratory analysis may use Contract Laboratory Program (CLP) procedures, but do not usually use the laboratory validation or documentation procedures required of CLP Level 4 analysis.
- Confirmational (DQO Level 4): This provides the highest level of data quality. These analyses require full CLP analytical and data validation procedures by the laboratory in accordance with USEPA recognized protocol.
- Non-Standard (DQO Level 5): This refers to analysis by non-standard protocols, for example, when exacting detection limits or when analysis of an unusual chemical compound is required. These analyses often require method development or adaptation. The level of quality control is similar to DQO Level 4 data.

The analytical support levels which will be used to generate the project data fall within DQO Levels 1, 2 and 3 (Tables B2-1 and B2-3).

B2.6 Project Schedule

In accordance with the SOW, the pre-design site investigation work will be initiated within 30 days of receiving written authorization to proceed from the USEPA. Sampling activities will be as soon as authorization is provided and site access is secured. The preliminary project schedule is presented as Figure 4-1 of the Work Plan.

B3. Project Organization And Responsibility

ARCADIS Geraghty & Miller has been retained by the North Bronson PRP Group to coordinate the Pre-Design Studies. A project organization and responsibility chart depicting management structure and lines of communication is presented on Figure B3-1.

The project organization chart identifies the Project Coordinator, Project Manager, and other ARCADIS Geraghty & Miller personnel that will be responsible for achievement of the project objectives and completion of the scope of work. Laboratory and Agency key personnel are also indicated on the chart. The various responsibilities of key project personnel are defined below.

B3.1 ARCADIS Geraghty & Miller Project Coordinator

The Project Coordinator has overall responsibility for ensuring that the project meets the stated objectives. In addition, the coordinator is responsible for senior review and technical quality control and will provide the Project Manager with access to ARCADIS Geraghty & Miller corporate resources.

B3.2 ARCADIS Geraghty & Miller Project Manager

The ARCADIS Geraghty & Miller Project Manager is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The Project Manager's primary function is to ensure that technical, financial and scheduling objectives and milestones are achieved successfully.

B3.3 Technical Staff

The technical staff (team members) for this project will originate from a pool of trained and experienced environmental professionals. The technical team staff will collect and analyze data and prepare various task reports and support materials. All of the technical team members will be experienced professionals who possess the degree of specialization and technical competence required to perform the required work effectively and efficiently.

B3.3.1 Field Team Leader

The ARCADIS Geraghty & Miller Project Manager will be supported by the Field Team Leader, who will be responsible for directing and coordinating the day-to-day activities of the various resource specialists under his/her supervision. The field team leader will be an experienced environmental professional and will report directly to the Project Manager on a daily basis while field activities are underway.

B3.3.2 Data Reviewer

ARCADIS Geraghty & Miller's data reviewer will be responsible for assessing final analytical reports from the laboratory as indicated in Section 10.0 of this FSQAP.

B3.3.3 Engineering Evaluation Leader

ARCADIS Geraghty & Miller's Engineering Evaluation Leader will be responsible for overseeing the technical team that will evaluate engineering actions for the Site. The Engineering Evaluation Leader will be involved with the project during its early stages, including the investigation stage, to guide data collection activities such that data will be useful for the engineering evaluation.

B3.4 STL Quanterra Management

The laboratory selected to perform chemical analysis of the pre-design study samples is STL Quanterra of North Canton, Ohio.

B3.4.1 Laboratory Operations Manager

The STL Quanterra Operations Manager will:

- Coordinate laboratory analyses.
- Supervise in-house chain-of-custody.
- Schedule sample analyses.
- Oversee data review.
- Oversee preparation of analytical reports.

It will also be the responsibility of the Laboratory Operations Manager to approve final analytical reports prior to submission to the ARCADIS Geraghty & Miller Data Reviewer.

B3.4.2 Laboratory Quality Assurance Officer

The STL Quanterra Quality Assurance Officer (QA Officer) will overview laboratory QA, overview QA/QC documentation, and conduct detailed data review. The QA Officer will decide if laboratory corrective actions are required in addition to seeing that laboratory Standard Operation Procedures (SOPs) are followed.

B3.4.3 Laboratory Sample Custodian

The laboratory sample custodian will be responsible for the following tasks:

- Receive and inspect the incoming sample containers.
- Record the condition of the incoming sample containers.
- Sign appropriate documents.
- Verify chain-of-custody and its correctness.
- Notify the Laboratory Operations Manager and laboratory supervisor of sample receipt and inspection.
- Assign a unique identification number and customer number, and enter each into the sample receiving log.
- With the help of the Laboratory Operations Manager, initiate transfer of the samples to appropriate lab sections.
- Control and monitor access/storage of samples and extracts.

Primary responsibility for project quality rests with the ARCADIS Geraghty & Miller Project Manager. Independent QA will be provided by the Laboratory's QA Officer prior to release of all data to ARCADIS Geraghty & Miller.

B4. Quality Assurance Objectives For Data Measurement

The overall QA/QC objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analyses and reporting that will provide results that have a degree of accuracy to complete the Pre-Design Studies field investigation. Specific procedures for sampling, chain of custody, laboratory analyses, reporting of data, internal quality control, audits, preventive maintenance of field equipment and corrective action are described in other sections of this FSQAP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

B4.1 Quality Control (QC) Samples

Duplicate, equipment rinsate blank, field blank, trip blank, and matrix spike/matrix spike duplicate (MS/MSD) samples will be analyzed to assess the quality of the data resulting from the field sampling program. The anticipated total numbers of QC samples are indicated on Table 2-1. A brief discussion of the purpose, frequency and mode of collection for the QC samples follows:

Duplicates: Duplicate samples are analyzed to check for sampling and analytical reproducibility. The general frequency will be one field duplicate for every 10 investigative samples collected, plus one field duplicate for each incremental batch of samples fewer than 10. Duplicate samples will not be collected for subsurface soil and sediment samples, since soil samples are difficult to replicate in the field due to normal variation in soil properties that occurs across different horizons. All duplicates will be submitted to the laboratory as “blind” samples (i.e., the sampling location will be recorded in the field log book but not on the chain-of-custody).

Equipment Rinsate Blanks: Equipment rinsate blank samples are analyzed to check for procedural contamination at the site that may cause sample contamination. Equipment rinsate blanks will be prepared in the field, using laboratory-grade deionized water, by allowing the water to flow over/through the sampling implement (e.g., split-spoon sampler, pump housing, etc.) and into sample containers with the appropriate preservative. The general frequency of submittal will be one equipment rinsate blank for every 20 investigative samples, plus one rinsate blank for each incremental batch of samples fewer than 10.

Field Blanks: Field blanks provide a check, in the case of equipment rinsate blanks, on whether the distilled water used to prepare the blanks is a potential source of

extraneous sample contamination. Since they are prepared on-site, field blanks can also indicate the potential presence of airborne contaminants that could bias sample results. Field blanks will be prepared at a frequency of one per every equipment rinsate blank submitted for laboratory analyses.

Trip Blanks: Trip blanks are used to assess whether cross-over of constituents between samples occurs during sample shipment and storage. One laboratory-supplied trip blank, consisting of high-grade deionized water (e.g., laboratory “purge” water) will be included along with each shipment of samples to be analyzed for Volatile Organic Compounds (VOCs), only.

Matrix Spikes and Matrix Spike Duplicates (MS/MSD): Matrix spikes provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and are hereinafter referred to as matrix spike/matrix spike duplicate (MS/MSD) samples. One MS/MSD will be collected for every 20 investigative samples per sample matrix, plus one MS/MSD sample for each incremental batch of samples fewer than 10. MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs. However, aqueous MS/MSD samples must be collected at triple the volume for VOCs.

Sampling procedures are further specified in the SSP (Section 5.0). All QC samples will be packaged and shipped to the laboratory at the same time as the investigative samples and, if possible, within the same shipping coolers.

The level of QA/QC effort provided by the offsite laboratories will meet the analytical DQO Levels indicated on Table B2-1. The level of QA/QC effort for each test will conform to the protocols of the corresponding USEPA methods listed in Table B2-2.

The QA/QC level of effort for the field measurements will consist of daily calibration checks of instrument readings, using standard references. Field measurement procedures are outlined in the equipment SOPs, included herein as Attachment A.

B4.2 Accuracy, Precision and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. These include the required accuracy, precision and sensitivity of the analyses. Procedures for measurement of temperature, pH, specific conductance, dissolved oxygen and oxidation-reduction potential (ORP) using field equipment are

included in manufacturer's instructions, which will be reviewed by the field staff prior to the commencement of field activities.

B4.3 Completeness, Representativeness and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that the selected project laboratory, STL Quanterra Environmental Services of North Canton, Ohio, will provide data meeting QA/QC acceptance criteria for 95 percent or more of the soil and aqueous samples tested using USEPA standard methods. Internal laboratory QA/QC is established to meet completeness criteria within the laboratory method SOP. Following completion of the analytical testing, the percent completeness will be calculated by the project laboratory using the following equation:

$$\text{Completeness(\%)} = \frac{\text{Number of valid data}}{\text{Number of samples collected for each parameter}}$$

Data sets which are below 95 percent complete will be reviewed to determine the cause.

Representativeness expresses the degree to which the data accurately and precisely represent:

- A characteristic of a population.
- Parameter variations at a sampling point.
- A process condition.
- An environmental condition.

Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and proper laboratory protocol. Representativeness will be satisfied by ensuring that the:

- Correct sampling procedures, as outlined in Section 5, are followed and proper sampling techniques are used.

- Proper analytical procedures are followed.
- Holding times of the samples are not exceeded in the laboratory.

Representativeness will also be assessed by the analysis of field duplicate samples.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the FSQAP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA/QC objectives.

B5. Sampling Procedure Plan (SPP)

B5.1 Introduction

The purpose of this SPP is to present the sampling protocols and QA/QC measures that will be employed during completion of field activities for the Pre-Design Studies investigation at the Site. The locations of the proposed field activities are presented on Figure 2-1 of the Work Plan.

Field activities described in the Work Plan will constitute a single phase of work. Soil borings, monitoring well installation, abandonment of the galvanized monitoring wells, monitoring well development, monitoring well sampling, sediment sampling and in-situ hydraulic conductivity tests will be completed within the same general time frame. Other activities such as staff gauge installation will be completed concurrently with the drilling and groundwater sampling activities.

The SPP is derived from ARCADIS Geraghty & Miller field sampling protocols which are based on technically sound, standard practices such as those published in the following documents:

- "Handbook for Sampling and Preservation of Water and Wastewater" (USEPA, 1982).
- "CERCLA Groundwater Monitoring Technical Enforcement Guidance Document" (USEPA, 1986).
- "Quality Assurance/Quality Control Guidance for Removal Activities" (USEPA, 1990).
- "Preparation of Soil Sampling Protocol, Techniques and Strategies" (Mason, 1983).
- "Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers" (USEPA, 1992).

The ARCADIS Geraghty & Miller protocols were developed to encourage and facilitate work that is, to the extent reasonably achievable, uniform and high quality.

The following field activities, as described in the Work Plan, are planned:

- Completion of soil borings for collection of subsurface soil/sludge samples and installation of monitoring wells.
- Collection of subsurface soil/sludge samples for laboratory analysis.
- Installation of monitoring wells and monitoring well nests.
- Development of new monitoring wells and re-development of existing monitoring wells.
- Installation of staff gauges in CD #30.
- Abandonment of existing galvanized steel monitoring wells.
- Collection of groundwater level measurements.
- Collection of groundwater samples for field geochemical measurements and laboratory analyses.
- Conduct in-situ hydraulic conductivity tests.
- Collection of sediment samples for laboratory analyses.

The remaining sections of this SPP present procedures for sample designation, identification and documentation. Field procedures are also described including:

- Subsurface drilling.
- Sample collection.
- Monitoring well installation.
- Hydraulic conductivity testing.
- Disposal of investigation-derived wastes, such as soil cuttings, well purge water, decontamination water and used personal protective equipment (PPE).

B5.2 Sample Designation

A sample designation system will be used to identify samples for laboratory analyses. A list of identifiers used for each sample will be maintained in the project log book by the ARCADIS Geraghty & Miller Field Team Leader.

Each sample that is collected will be designated by a unique sample identification number. The first part of the identifier will correspond to the type of media being collected:

- SB - Soil Boring
- SD - Sediment Sample
- GW - Groundwater Well
- FB - Field Blank
- TB - Trip Blank
- EB - Equipment Blank (i.e., rinsate blank)

For example, field blanks will have an FB followed by the alphabetic code for the media type of blank (i.e., a groundwater blank will be FBGW). All samples, including blanks but not MS/MSD samples (see below), will be assigned a unique sample number. The field sampling personnel will indicate in the log book the sampling equipment corresponding to each equipment blank. Trip blanks will be similarly identified.

The sample type code will be followed by an alpha-numerical code indicating the sample location number. For soil samples, the two-digit numerical code will be followed by a four-digit numerical code that indicates the depth of the soil sampling interval. For example, SB-2/08-10 indicates a soil sample collected at a depth of 8 to 10 feet below land surface (bls) from Soil Boring 2 at the Site.

Field duplicates will be identified with a unique sample identification number, such that the laboratory will not be aware that the sample is a duplicate (i.e., "blind duplicates"). The field sampling personnel will note in the log book the duplicate samples so this information will be available when the laboratory data is reviewed.

MS/MSD samples are not separate samples; therefore, they are not assigned unique sample numbers, as are the field duplicates, equipment blanks, and trip blanks. The only difference between a MS/MSD sample and a standard sample is that additional sample volume is collected at the location that the MS/MSD sample is obtained. These samples will be identified by adding "MSD" to the identifier of the sample where the MS/MSD sample is collected.

B5.3 Field Procedures

This section discusses the field methodologies and sampling procedures to be employed during the Pre-Design Studies investigation at the Site. The number of samples and analyses to be performed on the various samples are presented in Table B2-1. A summary of the required sample containers, preservatives and maximum holding times for the samples to be collected and analyses to be performed are presented in Table B5-1.

B5.3.1 Completion of Soil Borings for Soil Sampling and Well Installation

Soil borings will be completed for the purpose of collecting representative soil samples to determine subsurface geology and groundwater conditions. Ten (10) soil borings will be completed in the area of the former Eastern Lagoon area to determine the vertical extent of waste material. Eleven soil borings will be advanced for the installation of groundwater monitoring wells at the Western Lagoon Area. Specific information regarding the borings is outlined in the Work Plan.

The soil borings will be completed utilizing a drill rig equipped with hollow stem augers. Hollow stem augers generally create a borehole ranging from 6 inches to 8 1/4 inches in diameter. The hollow stem auger drilling method has been chosen as the anticipated borehole depths are relatively shallow (less than 35 ft bls), and the augers will case off the borehole in unconsolidated sediments thus allowing for continuous sampling and monitoring well installation following borehole sampling. Boreholes will be continuously sampled by advancing a 2 ft long by 2 inch diameter steel split-spoon attached to a drill rod of the same diameter through the hollow stem augers. Continuous soil sampling will be conducted according to the following procedure:

1. Advance the split-spoon into undisturbed soils at the base of the hollow stem auger drill bit with a standard 140 pound hammer.

2. Retrieve the split-spoon with the sample inside the split-spoon while the augers remain in place.
3. Remove the soil sample from the split-spoon.
4. Advance the hollow stem augers to the base of the sampled interval (2 ft).
5. Repeat the process by advancing the split-spoon another 2 ft below the base of the augers, until the target depth of the soil boring is reached.

Prior to drilling at each location, the borehole equipment will be steam-cleaned to reduce the potential for cross-contamination from other boreholes. The soil sampling equipment (split-spoon, etc.) will be cleaned between each soil sampling depth interval by washing with a laboratory-grade soap and tap water solution, followed by a distilled water rinse. The proposed protocol for decontamination of sampling equipment is included as Attachment B.

Upon retrieval and opening of the split-spoon, the soil samples will be screened with an FID or PID to evaluate the potential presence and concentrations of VOCs. The soil samples will be described by the field geologist. The description will include:

- Estimated grain size and grain size distribution.
- Approximate degree of sorting.
- Color.
- Apparent moisture.
- Odor.
- Other characteristics, as appropriate.

Each sample will be classified in the field on a sample/core log, as shown in Attachment C. Geologic descriptions will be recorded by the field geologist onto the log, and will include sample descriptions, FID readings and depth to water. Disposable nitrile type gloves will be worn by the field staff during the collection of samples to minimize potential cross-contamination.

If elevated levels of organic vapors are detected with the FID during sample logging, the procedures outlined in the Site Health and Safety Plan (HSP) will be followed to determine the appropriate level of personnel protection.

B5.3.2 Collection of Subsurface Soil Samples for Laboratory Analyses

Subsurface soil samples for laboratory analyses will be retained from the 10 soil borings advanced in the Eastern Lagoons area, as described in the Work Plan. The following general procedures will be employed for subsurface soil sampling:

- The borehole number will be recorded in the field book and on the boring log.
- All necessary sample containers will be prepared and labeled.
- Each borehole will be drilled using hollow stem auger drilling techniques; samples will be collected continuously over 2-foot intervals.
- Drilling will proceed to the start of the sampling depth (bottom depth of the last sample) in each boring, a soil sample will then be obtained by advancing a split-spoon as described in Section 5.3.1.
- As the split-spoon is recovered from the borehole, the sample will be extracted from the split-spoon and immediately screened for the potential presence of VOCs, using an FID.
- All samples potentially subject to laboratory analyses will be put in appropriate sample containers and placed on ice in a cooler.
- The lithology of the sample will then be described on the sample/core log. The description will include the major and minor components, color, consistency or density, relative moisture content and any other observations.
- All sampling equipment will be decontaminated using a laboratory-grade detergent and water solution, followed by a distilled water rinse. A sufficient number of split-spoons will be kept in the field to achieve uninterrupted sampling. The drilling equipment and split-spoons will be decontaminated by steam cleaning prior to beginning each soil boring.
- Any soil borings not used for the installation of monitoring wells will be

abandoned upon completion in accordance with applicable Michigan regulations, using bentonite chips or a bentonite-cement grout tremied from the bottom of the borehole.

- All soil cuttings will be drummed, stored and clearly marked for future consolidation into the Western Lagoons, prior to Lagoon closure.

Equipment for the soil borings and subsurface soil sampling will include the following:

- Personnel safety equipment, including the FID.
- Log book, sample/core log, markers and pens.
- New, clean laboratory supplied sample containers meeting the criteria identified in applicable guidance (USEPA, 1992).
- Hollow stem auger drilling equipment with continuous sampling capabilities.
- Two foot sampling split-spoon (will enable 2 foot sample recovery).
- Coolers with ice.
- Distilled water, laboratory grade detergent, wash tubs, spray bottles, and a steam cleaner.
- Disposable nitrile gloves.
- Stainless steel trowel and/or spoon, for removing sample from the split-spoon and transferring it into sample jars.

B5.3.3 Collection of Sediment Samples for Laboratory Analysis

Sediment samples will be collected from CD #30. CD #30 is approximately 6 ft wide, with a surface water flow direction from east to west.

Sediment samples will be collected utilizing a shovel or hand auger, as appropriate. If water depths greater than 3 ft are encountered, the sediment samples will be collected using an EkmanTM dredge sampler or similar device. Sediment sample collection will

begin at the furthest downstream sample location and proceed to the most upstream location. Sediment samples will be collected at each location from the sediment surface (from the 0 to 6 inch depth interval) near the center of the drainage channel (i.e., the area most subject to normal flow in the ditch).

Upon collection, the sediment samples will be immediately placed into laboratory-supplied containers and placed in a cooler on ice. The sediment samples will be submitted to the project laboratory under proper chain-of-custody procedures and analyzed for the analytical parameters listed in Table B2-1.

All sediment sampling equipment will be cleaned between each sample by washing and rinsing with laboratory-grade soap and distilled water. The recommended protocol for decontamination of sampling equipment is included as Attachment B. All sampling personnel will be equipped with waterproof outer garments (e. g., waders or boots). Disposable nitrile gloves will be used and changed prior to the collection of each sediment sample.

B5.3.4 Installation and Development of Monitoring Wells

The soil borings for the installation of the monitoring wells will be advanced to their respective total depths using the hollow stem auger drilling techniques described in Section B5.3.1. When the appropriate borehole depth has been reached, as determined by the field geologist, each monitoring well will be constructed inside of the hollow stem augers. When the well construction is complete, the augers will be removed from the boring.

Groundwater monitoring well nests, consisting of two wells per nest, will be installed in two locations in the Western Lagoon area and in two locations in the Eastern Lagoon area. A well nest will include a water table well and one deeper well screened below the water table in the shallow water-bearing unit (SWBU). Three shallow groundwater monitoring wells will be screened intersecting the water table around the outside perimeter of the Western Lagoon area, to provide lateral coverage of potential COC migration.

Each monitoring well will be constructed of 2-inch I.D., Schedule 40 polyvinyl chloride (PVC) casing and a 10-foot long, factory-cut, PVC screen with 0.010-inch slots. The PVC will meet American Society for Testing and Materials (ASTM) D1785 specifications. A typical monitoring well construction detail is provided in Attachment D.

Following placement of the monitoring well casing and screen in the borehole, a filter pack of clean, graded silica sand will be placed in the annular space between the well and the borehole, to a level approximately 2 ft above the top of the well screen. A filter pack seal, consisting of fine silica sand followed by hydrated (potable water) bentonite, will be added above the filter sand pack where the total depth of the well permits (see Figures 2-4 and 2-5 in the Work Plan). At the surface, a concrete cap that extends below the frost zone and slopes away from the well casing will be installed. A protective steel casing, with a locking cap designed to protect the portion of the well casing above the ground surface, will be set just prior to pouring the concrete cap.

The depth of the borehole bottom, bottom of screen, top of filter pack, top of filter pack seal, and top of annular space seal will be measured and recorded to the nearest ± 0.01 ft. The following information will also be measured or calculated and recorded:

- Volume of sand required and used.
- Volume of bentonite required and used.
- Borehole and well casing diameters.
- Height of the well casing (without cap and plug).

Each monitoring well will be developed no sooner than 24 hours after well installation. The monitoring wells will be purged using a submersible pump or drilling equipment which can be used for water extraction. Development will continue until one of the following conditions are met:

- The well produces clear sediment-free water.
- A minimum of 5 well volumes of groundwater have been excavated from the well.
- The well has been purged dry a minimum of 3 times.

The water produced during development will be handled as described in Section B5.4 of this FSQAP.

Dispersing agents, acids, disinfectants, or other additives will not be used during development, nor will they be introduced into the monitoring well at any other time. The following data will be recorded as part of well development:

- The static water level measured from the top of the well casing, before and after development is complete.
- The calculated quantity of fluid standing in the well prior to development.
- The sounded well depth before and after development, to determine if siltation has occurred inside the well.
- The physical character of water removed including changes in clarity, color, visible particulate and odor that occur during development.
- Temperature, pH, and specific conductance values.
- The development technique used.
- Quantity of water removed during well development.

The drill rig, rods, screens, casing and other equipment that are used to construct the wells will be decontaminated before operations begin at each monitoring well location. The equipment will also be decontaminated before the equipment is allowed to leave the Site. The decontamination will be conducted using steam cleaners or high-pressure water sprayers and water from a known, uncontaminated source.

The well location coordinates and elevations will be surveyed by a registered land surveyor and will then be transferred to the site base map (Figures 2-1 of the Work Plan). Elevations will be measured to the nearest 0.01 ft, relative to mean sea level, and the location (northing, easting) will be surveyed relative to Michigan State Plane coordinates.

B5.3.5 Staff Gauge Installation

Two staff gauges will be installed in CD #30. The surface water elevation will be recorded from a graduated face on the staff gauge. The staff gauge locations and elevations (top-of-gauge) will be surveyed by a registered land surveyor. The staff gauge locations will be marked and included on the topographic base map.

B5.3.6 Abandonment of Galvanized Monitoring Wells

Well abandonment procedures will conform to current, applicable Michigan Department of Environmental Quality (MDEQ) requirements and Michigan Department of Public Health (MDPH) Code, Act 368. P.A. of 1978, Part 127, known as the Groundwater Quality Control Act, and its Administrative rules. First, the borehole surrounding each well to be abandoned will be enlarged by “over-drilling,” to facilitate removal of the casing. The existing casing, screen and other well components will be extracted from the borehole and either containerized or wrapped in polyethylene plastic for subsequent consolidation into the Western Lagoon area or off-site disposal, as deemed fit. The open borehole will then be filled with bentonite chips to approximately 6 inches bls and finished to match the existing surface (e.g., earth, asphalt, etc.) in the well vicinity. The depth of over-drilling and volume of sealant used to fill the borehole will be recorded in the field book.

B5.3.7 Collection of Groundwater Level Measurements

- Static groundwater measurements will be recorded from the monitoring wells at various times during the Pre-Design Studies investigation. Groundwater levels will be measured from a consistent point on each well at the northside, on the top of the well casing (not on the protective cover), using a clean water-level measuring indicator to an accuracy of ± 0.01 ft. The general procedures to be followed for the collection of groundwater level measurements and well depths from the monitoring wells are as follows:
- Check that the water-level measuring indicator battery is functional.
- Decontaminate the water-level indicator and any attached tape with laboratory-grade soap and distilled water.
- Remove cap from well, and allow well to vent. Check for sharp edges which may damage tape and located measuring point. Don disposable nitrile gloves.
- Lower the indicator into the center of the well until a contact with the water surface is indicated by either audible alarm or light.
- Mark and hold the tape at the measuring point (tip of well casing), and repeat the measurement.

- Read off the measurement and record measurement to the nearest ± 0.01 ft.
- Lower indicator (tape) to the bottom of the well. Raise indicator slowly until there is no slack in the tape. Gently "feel" the bottom of the well by slowly raising and lowering the water level indicator.
- Read off the measurement and record.

The following field equipment is required for water level measurements:

- Appropriate health and safety equipment (e.g., personal protective equipment [PPE], field instruments, etc. - see the HSP for more detail [Appendix C]).
- Log book and marking pens.
- Water level indicator graduated in 0.01 ft increments.
- Laboratory-grade detergent, brush, bucket, spray bottle and wash tub.
- Distilled or deionized water for equipment decontamination.
- Laboratory-prepared deionized water (e.g., "purge" water) for preparation of equipment rinsate blanks and field blanks.
- Disposable nitrile gloves.
- Tools and/or keys required for opening wells.
- Camera and film.

B5.3.8 Groundwater Sampling and Laboratory Analyses

This section discusses groundwater sampling procedures for the Site. Existing monitoring wells will be re-developed, where necessary, prior to sampling to encourage flow of formation water into the well screens and reduce sample turbidity. A summary of the groundwater sampling program, including the analytical parameters, is provided in Table B2-1.

Field instruments will also be used to measure groundwater characteristics at each of the monitoring wells. The field measurements will include: temperature, pH, specific conductance, dissolved oxygen and ORP.

The following protocol has been developed to obtain samples that provide representative groundwater quality information. It is intended for use in sampling the monitoring wells during the Pre-Design Studies investigation and subsequent investigations and/or monitoring events. Low-flow purging and sampling techniques will be used during well evacuation and groundwater sampling. If low-flow sampling techniques prove non-operational due to field conditions (e.g., depth to static groundwater greater than approximately 25 ft bls), purging and sampling will be conducted using either a positive displacement (e.g., piston) pump or dedicated, polyethylene, bottom-filling bailers.

- Well evacuation procedures will be as follows:
- The monitoring well will be identified, and its designation will be recorded on a water sampling log (Attachment E).
- The top of the monitoring well will be cleaned with a clean rag to prevent loose particulate matter from falling into the well.
- The measuring tape or water-level indicator will be decontaminated with a laboratory-grade solution wash and rinsed thoroughly with distilled water, and the depth to groundwater will be measured.
- The volume of water in the monitoring well will be calculated.
- The wells will be purged at a rate between 100 and 500 milliliters per minute (mL/min), using a low-flow peristaltic or positive displacement pump with a rheostat-type flow control device and new, dedicated polyethylene tubing. Field measurements of temperature, pH, specific conductance, dissolved oxygen, and ORP will be recorded during groundwater purging. Well evacuation will continue until these field parameters have stabilized. To the extent practical, the purge rate will be set so as to minimize drawdown within the wells. The pump will first be decontaminated following the protocol outlined in Attachment B.

The monitoring well sampling procedures will be as follows:

- The groundwater samples will be collected utilizing the low-flow pump and dedicated polyethylene tubing. Once samples have been collected, they will be prepared and preserved in accordance with the requirements listed in Table B5-1, and placed immediately into an ice-filled cooler. In addition, field personnel will avoid application of insect repellent, perfume, cologne, sunscreen and/or moisturizer prior to sampling monitoring wells, to avoid contaminating the monitoring wells with these items. Disposable nitrile gloves will be worn by the sampling personnel and discarded into designated drums in-between each sampling location.
- The sample jars will be provided by the project laboratory and will meet appropriate criteria (USEPA, 1992). The sample jars will contain the appropriate chemical preservative, and the laboratory will pre-label the jars indicating the specific preservative used. Samples for dissolved metals analyses will be filtered in the field, using a 0.45-micron filter in-line with the pump-and-tubing assembly, prior to being placed into the acidified sample containers.
- The temperature, pH, specific conductance, ORP and dissolved oxygen concentration of the groundwater sample will be measured in the field using handheld meter(s) inserted into the flow-through cell.
- All measurement instruments contacting the groundwater sample will be decontaminated with a laboratory-grade detergent solution wash and rinsed with distilled water.
- Water sampling data will be recorded on a water sampling log (Attachment E).

B5.3.9 In-situ Hydraulic Conductivity Tests

In-situ hydraulic conductivity tests will be conducted in the proposed new monitoring wells along CD #30 during the Pre-Design Studies field activities to estimate the target flow rate into the provisional french drain system. In-situ hydraulic conductivity tests are a method of obtaining approximate values of horizontal hydraulic conductivities in the immediate vicinity of the monitoring well. To obtain representative aquifer parameters, the monitoring wells to be tested will be selected based upon their spatial

distribution across the area, as well as on the screened intervals and the lithologies associated with the screened intervals.

The slug test method will consist of quickly displacing a volume of water in the well with an inert object (slug) and recording the subsequent change in water levels over time, as the water level recovers to static conditions. The slug will then be abruptly removed from the well and the change in the water level will be recorded as it recovers to static conditions (rising head test). A data logger and pressure transducer will be used to measure and record changes in the water levels.

Equipment for the slug testing is as follows:

- Slug.
- Hermit Data Logger (1000 C or equivalent).
- Electronic Water Level Indicator.
- Plastic Sheeting.
- Monitoring Well Keys.
- Flushmount monitoring well assessing tools.
- Field Log Book Entries.
- Groundwater Level Measurements.
- Bailer Decontamination.
- Transducer and cable.
- Well construction logs.
- Available analytical data.
- New Polypropylene rope (0.25 inch diameter).
- Duct tape.
- Laptop computer or printer.

- Mobile or cellular phone.

The procedure for the slug testing is as follows:

- Prior to mobilizing to the site, review the available analytical groundwater data and determine the order that the slug tests will be performed moving from the least contaminated well to the most contaminated well. Determine if more than one slug, transducer, or cable will be needed to minimize the potential for cross contamination.
- Decontaminate each piece of equipment that will be placed into the well, including the slug, that transducer and cable, and the electronic water level indicator.
- Open the well and measure depth to water and depth to the bottom of the well and record the measurements in the field log book. Compare the measurements to the well construction log. Determine if the amount of siltation in the well (if any) could impact the test. Evaluate the available water column, the depth at which the transducer will be set, and the length of the slug to determine how deep the slug can be introduced into the well without touching (damaging) the transducer.
- Connect the transducer to the Hermit Data Logger.
- Lower the transducer to approximately 6 inches to 1 ft above the bottom of the well (above the silted-in portion, if any). Secure the transducer cable to the well casing with duct tape to reduce the potential for cable movement.
- Take and record another water level measurement with the electronic water level indicator. Compare the results to the initial measurement. If there is no difference (>0.01 ft), proceed with the test. If there is a difference, wait a few minutes and re-measure the depth to water. If there is no change from the previous measurement, proceed. If there is a change, repeat measurements until the water level stabilizes. If the water level does not stabilize, contact the Project Manager to obtain further direction on whether the test should proceed.
- Set the Hermit Data Logger following the manufacturer's instructions.
- Verify that the knot attaching the rope to the slug is secure. Lower slug to just above the top of the water column in the well.

- Simultaneously start the Data Logger and lower the slug quickly and smoothly into water to the predetermined depth. Lower the slug enough to be completely submerged (even after recovery), if possible. Record the time test started in the field log book. Collect and record water levels with the electronic water level indicator during the test for comparison with the Data Logger test results.
- Secure the rope to prevent the slug from moving during the test.
- Continue recording data until water level has returned to the level recorded at the beginning of the test.
- To continue the “slug-out” portion of the test, collect and record one more measurement at the next time interval prior to removing the slug.
- Prepare to perform the slug-out portion of test by pressing the appropriate buttons on the Data Logger.
- Grip the rope and pull the slug quickly and smoothly out of the well. Avoid contact with the traducer cable during slug removal. Place on plastic sheeting. Record the time the slug was removed in the field book.
- Continue recording data until the water level returns to static elevation or until the unit time limit of the test is reached. Stop the Data Logger. Take another water level measurement and then remove the transducer and cable from the well.
- Decontaminate each piece of equipment that comes in contact with water from the well per the procedures outlined in Attachment B.
- Measure the depth to water with the electronic water level interface probe and record in the field log book.

B5.3.10 Decontamination Procedures

Decontamination procedures will be during all field tasks so that the data collected is representative of the field conditions, and is not affected by cross-contamination. Decontamination procedures are documented more fully in the Equipment SOPs (Attachment A), and the Equipment Decontamination Procedures (Attachment B), and include the following procedures:

- Changing gloves between each sample collected in the field.
- Requiring all downhole drilling equipment be cleaned between samples.
- Requiring steam cleaning of augers and drilling equipment between borings.
- Placing samples for laboratory analysis in unused glassware provided by the laboratory.
- Using new dedicated bailers at each monitoring well (if bailers are used).
- Requiring all pumps, water level indicators and other downhole equipment to be cleaned before use.

B5.4 Disposal Of Investigation-Derived Materials

During the course of soil boring completion, monitoring well installation and other field activities, the following investigation-derived materials are anticipated to be generated:

- Disposable, used PPE.
- Drill cuttings.
- Water collected during well development and groundwater sampling.

Typical used PPE (anticipated to be non-hazardous waste) will be placed into plastic trash bags. Grossly contaminated PPE may be evaluated further for disposal options, as outlined in the HSP. The bags will be tied and disposed of with daily trash.

Fluids generated during drilling, monitoring well installation and development, and monitoring well purging will be stored in temporary aboveground tanks or labeled 55-gallon U.S. Department of Transportation (DOT)-approved drums until discharged into either the City of Bronson Wastewater Treatment Plant or the Western Lagoons.

Similarly, soil cuttings and sludge like material generated during drilling will be contained in 55-gallon U.S. Department of Transportation (DOT)-approved drums and stored for future disposal into the Western Lagoon area, in a manner consistent with the approved remedial action.

B5.5 Documentation

Field logbooks will be used to record all daily activities performed at the Site. Entries will be written in sufficient detail such that a particular situation can be reconstructed. Logbooks will be bound, field survey books, marked with the Site name on the front and inside covers. Logbooks will be assigned to field personnel, but will be stored securely in the office when not in use. After project completion, the ARCADIS Geraghty & Miller Project Manager will maintain custody of these documents.

Entries into the logbook will contain a variety of information including the:

- Date.
- Start time.
- Weather.
- All field personnel present.
- Level of personal protection being used on-Site.
- The signature of the person making the entry.

The names of visitors to the Site and the purpose of their visit will also be recorded.

ARCADIS Geraghty & Miller standard sample/core logs (Attachment C) will be used to record the lithology. Whenever a sample is collected or a measurement is made, a detailed description of sampling location and matrix will be recorded in the field logbook. All sample collection procedures will be documented on appropriate forms or in the logbook.

When a photograph is taken, a notation will be made in the logbook indicating:

- The date.
- Roll number.
- Photo number.

- Time.
- Direction that the camera is facing.
- Location.

B6. Sample Custody

Sample custody consists of three parts: (i) sample collection; (ii) laboratory analysis; and (iii) final evidence files (USEPA, 1985). Final evidence files, including all originals of laboratory reports and purge files, will be maintained under document control in a secure area.

A sample or evidence file is under your custody if they:

- Are in your possession.
- Are in your view subsequent to being in your possession.
- Are in your possession and you place them in a secured location.
- Are in a designated secure area.

B6.1 Field Chain-Of-Custody Procedures

The sample packaging and shipment procedures summarized below will be followed to ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering and other sample designations are included in the SPP.

B6.1.1 Field Procedures

The field sampler will be personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

All bottles will be labeled with sample numbers and respective sampling locations and/or sampling intervals in accordance with Section B5.2 of this FSQAP. Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.

B6.1.2 Field Logbooks/Documentation

The field logbook(s) will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the Site can re-construct a particular situation without reliance on memory.

Field logbooks will be bound, field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use.

The title page of each logbook will contain the following:

- Project name.
- Project start date.
- End date.

Entries into the logbook will contain a variety of information including the:

- Date.
- Start time.
- Weather.
- Names of all sampling team members present.
- Level of personal protection being used.
- The signature of the person making the entry.

The names of visitors to the Site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected, or a

measurement is made, a detailed description of the location of the station, which may include compass and distance measurements (if necessary or not obvious), shall be recorded. The number of the photographs taken of the station, if any, will also be noted, as described previously in Section B5.5.

Samples will be collected following the sampling procedures documented in the SPP. The following information will be recorded:

- Equipment used to collect the samples.
- Time of sampling.
- Sample description (based on visual observations and field classification techniques).
- Depth at which the sample was collected.
- Volume and number of containers.

Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive separate sample identification numbers, will also be noted.

B6.1.3 Transfer of Custody and Shipment Procedures

Samples will be accompanied by a properly-completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date and note the time on the record.

Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analyses, with a signed custody record enclosed with each shipment. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will in turn be covered with clear plastic tape. The cooler will be strapped shut with strapping tape in at least two locations.

All shipments will be accompanied by the chain-of-custody record that identifies the contents of the shipping container. The original record (white copy) will accompany

the shipment, and the pink and yellow copies will be retained by the sampler and returned to the office project file.

B6.2 Laboratory Chain-Of-Custody Procedures

Laboratory custody procedures for sample receiving and log-in, sample storage, tracking during sample preparation and analysis and storage of data are described in STL Quanterra's SOP. A copy of the laboratory SOP being submitted under separate cover.

B7. Calibration Procedures And Frequency

This section describes procedures for maintaining the accuracy of instruments and measuring equipment that are used for conducting field tests and laboratory analyses. The instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

B7.1 Field Instruments/Equipment

Field instruments will include:

- Thermometer.
- pH meter.
- Specific conductance meter.
- Dissolved oxygen meter.
- ORP meter.
- OVA (FID).

Multiple functions may be recorded by one meter. Equipment to be used during the field sampling will be examined to check that it is in operating condition. This includes checking the manufacturer's operating and instruction manual(s) for each instrument to maintain conformance with recommended operation and maintenance procedures. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service.

Instruments and equipment used to gather, generate or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications and ARCADIS Geraghty & Miller company standards. Equipment calibration procedures are included with the SOPs in Attachment A.

B7.2 Laboratory Instruments

Calibration of laboratory equipment will be based on approved, written procedures, as proscribed in the STL Quanterra SOP. Records of calibration, repairs or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed.

In cases where analyses are conducted according to the USEPA SW-846 protocols, the calibration procedures and frequencies specified in the applicable SW-846 methods will be followed. For analyses governed by the USEPA's "Methods For Chemical Analysis of Water and Wastes" protocol or laboratory SOPs, the applicable USEPA method or appropriate SOP will be used by the laboratory for the required calibration procedures and frequencies.

B8. Analytical Procedures

Soil and water samples collected during the field sampling activities for the EE/CA will be analyzed by STL Quanterra. The laboratory's mailing addresses is:

STL Quanterra
4101 Shuffel Drive, NW
North Canton, Ohio 44720

B8.1 Laboratory Analysis

The laboratory analytical methods to be used and corresponding practical quantitation limits (PQLs) are indicated in Table B2-2. SOPs used by the laboratory are based on analytical methods published in SW-846 and the USEPA's "Methods for Chemical Analysis of Water and Wastes" or standardized laboratory procedures, which specify:

- Procedures for sample preparation.
- Instrument start-up and performance check.
- Procedures to establish the actual and required detection limits for each parameter.
- Initial and continuing calibration check requirements.
- Specific methods for each sample matrix type.
- Required analyses and QC acceptance limits for method blanks, trip blanks (as appropriate), field blanks, matrix spikes, matrix spike duplicates and laboratory control samples (either USEPA or National Bureau of Standards [NBS] reference samples, such as Performance Evaluation (PE) samples, or laboratory prepared blanks and spikes).

B8.2 Field Screening Analytical Protocols

The procedures for field measurement of temperature, pH, specific conductance, dissolved oxygen, ORP and organic vapors are described in the equipment SOPs in Attachment A.

B8.3 Laboratory Procedures

Laboratory procedures used for analyzing the environmental samples will be performed in accordance with those specified in the associated laboratory SOPs and applicable USEPA guidance.

B9. Internal Quality Control Checks

This section describes the QA/QC procedures to be followed in the field and in the laboratory to maximize the integrity of the data that are collected.

B9.1 Field Sample Collection

The assessment of field sampling precision and accuracy will be made through collection of field duplicates and field blanks in accordance with the applicable procedures described in the SPP and at the frequency indicated in Table B2-1.

B9.2 Field Measurements

QC procedures for temperature, pH, specific conductance, dissolved oxygen and ORP measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by regularly calibrating the instruments.

B9.3 Laboratory Analysis

Two types of QA will be used by STL Quanterra to ensure the production of analytical data of known and documented quality and will consist of an internal QA program and QC checks.

B9.4 QA/QC Program

The project laboratory (STL Quanterra) has written, internal QA/QC programs that provide rules and guidelines to check routinely the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by the laboratory's Quality Assurance Unit (QAU), which is independent of the operating departments.

The stated objectives of the laboratory QA/QC Program are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures.
- Ensure that all analytical procedures have been validated and are conducted according to sound scientific principles.

- Monitor the performance of the laboratory through an inspection program, and provide for corrective actions, as necessary.
- Collaborate with other laboratories in establishing quality levels, as appropriate.
- Ensure that all data are properly recorded and archived.

All laboratory procedures are documented in writing as either SOPs or Method Procedures (MPs) that are edited and controlled by the QAU. Internal QC procedures for analytical services will be conducted by the laboratory in accordance with its SOPs and the individual method requirements, in a manner consistent with appropriate USEPA or other analytical methods.

B9.5 Quality Control Checks

Laboratory specifications include:

- The types of audits required (sample spikes, surrogate spikes, reference samples, controls and blanks).
- The frequency of each audit.
- The compounds to be used for sample spikes and surrogate spikes.
- The QC acceptance criteria for these audits.

The project laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be reanalyzed by the laboratory, if sufficient sample volume is available. It is expected that, barring extraordinary field conditions, sufficient volume of samples will be collected to allow for re-analysis, if necessary.

B10. Data Reduction, Assessment, And Reporting

This section describes the data reduction, assessment and reporting procedures to be followed to check continually the integrity of the data.

B10.1 Field Measurements And Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in the field log book. If the data are to be used in the project reports, they will be reduced and summarized, and the method of reduction will be documented in the report.

B10.2 Laboratory Services

STL Quanterra will perform in-house analytical data reduction and validation under the direction of its internal Laboratory QA Officers. The Laboratory QA Officer is responsible for assessing data quality and advising of any data that were rated "preliminary" or "unacceptable" or other notations that would caution the data user of possible unreliability. Data reduction and reporting by either laboratory will be conducted as follows:

- Raw data produced by the analyst is turned over to the respective area supervisor.
- The area supervisor reviews the data for attainment of quality control criteria as outlined in the USEPA's "QA/QC Guidance for Removal Activities" (USEPA, 1990).
- Upon acceptance of the raw data by the area supervisor, a computerized report is generated and sent to the Laboratory QA Officer.
- The Laboratory QA Officer completes a thorough audit of reports at a frequency of 1 in 10, and an audit of every report for consistency.
- The Laboratory QA Officer and area supervisors will decide whether any sample reanalysis is required.
- Upon acceptance of the preliminary reports by the Laboratory QA Officer, final reports will be generated and signed by the Laboratory Project Manager. The

laboratory package shall be presented in the same order in which the samples were analyzed.

For DQVS above Level III, STL Quanterra will prepare and retain full analytical and QC documentation similar to that required by the Contact Laboratory Program (CLP) for the relevant parameters. CLP-equivalent data packages will be provided to ARCADIS Geraghty and Miller.

The laboratory will report the data in the same chronological order in which it is analyzed along with QC data. The laboratory will provide the following information to ARCADIS Geraghty & Miller in each analytical data package submitted:

- Cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis.
- Tabulated results of inorganic and organic compounds identified and quantified.
- Analytical results for QC sample spikes, sample duplicates, initial and continuous calibration checks of standards and blanks, standard procedural blanks, laboratory control samplers and ICP interference check samples.
- Tabulation of instrument detection limits determined in pure water.
- When necessary, raw data system printouts (or legible photocopies) identifying date of analyses, analyst, parameters determined, calibration curve, calibration verifications, method blanks, sample and any dilutions, sample duplicates, spikes and control samples.

For organic analyses, the supporting data packages will include matrix spikes, matrix spike duplicates, surrogate spike recoveries, chromatogram, GC/MS spectra and computer printouts.

All data generated by STL Quanterra will be computerized in a format organized to facilitate data review and evaluation. The computerized data set will include the data qualifiers provided by STL Quanterra in accordance with the "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses" (February 1988). The laboratory-provided data qualifiers will include such items as

- Concentration below required detection limit.

- Estimated concentration due to poor spike recovery.
- Concentrations of chemicals also detected in the laboratory blank(s).

ARCADIS Geraghty & Miller's data assessment will be accomplished by the Data Reviewer. The data assessment will be based on the assumption that the sample was properly collected and handled according to the SPP and the Sample Custody section of this FSQAP, taking into account qualifiers and case narratives provided by the analytical laboratory. The ARCADIS Geraghty & Miller Data Reviewer will conduct a systematic review of the data by checking whether holding times were met and the results of blank analyses. For organic analyses, the results of surrogates will also be checked by the Data Reviewer. The data review process will include interaction with the laboratory to correct data deficiencies and obtain additional information, if appropriate.

Following review and validation, sample results will be archived in a Microsoft ® Access or similar database file, which will enable production of summary tables, graphs and other output for relevant reports and submittals.

B11. Performance and System Audits

Performance and system audits of both field and laboratory activities will be conducted to document that sampling and analysis are performed in accordance with the procedures established in this FSQAP. The audits of field and laboratory activities include two separate, independent parts: internal audits; and external audits.

B11.1 Field Audits

Internal audits of field activities (sampling and measurements) may be conducted by the ARCADIS Geraghty & Miller Project Manager and/or Field Team Leader. The audits normally include examination of field sampling records and field instrument operating records (including calibration data) to investigate whether:

- Sample collection, handling and packaging were apparently performed in compliance with the established procedures.
- Proper QA/QC procedures, including those specified in this FSQAP, were executed.
- Secure sample chain-of-custody was maintained.

These audits may occur at the onset of the project to check that all established procedures are followed. Follow-up audits may be conducted to correct deficiencies, and check that QA procedures are maintained throughout the investigation.

B11.2 Laboratory Audits

The internal performance and system audits of laboratories may be conducted by the ARCADIS Geraghty & Miller Project Manager and/or his/her designee. The system audits include examination of laboratory documentation on:

- Sample receiving.
- Sample log-in.
- Sample storage.
- Chain-of-custody procedures.

- Sample preparation and analysis.
- Instrument operating records.

The performance audits include blind QC samples prepared and submitted along with project samples to the laboratory for analysis throughout the project. The analytical results of these blind performance samples are evaluated to document that the laboratory is conducted its scope of work according to established methods and standards, as referenced in this FSQAP.

External laboratory audits may be conducted by the USEPA and/or the Michigan Department of Environmental Quality (MDEQ).

B12. Preventative Maintenance Procedures

This section describes the preventative maintenance procedures used on the field and laboratory equipment to ensure the integrity of the data.

B12.1 Field Equipment And Instruments

The field equipment for this project includes:

- Thermometers or thermocouple temperature meters.
- pH meters.
- Specific conductance meter.
- Dissolved oxygen meter.
- ORP meter.
- Organic vapor analyzer (OVA), also known as an FID.

Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturer.

Field instruments will be checked and calibrated before they are shipped or carried to the field. These instruments will be checked and calibrated daily before use or in accordance with manufacturers' guidelines. Instrument instructions are included in the equipment SOPs in Attachment A.

Critical spare parts such as pH probes, electrodes, and batteries will be kept on-site to minimize instrument downtime. Backup instruments and equipment will be available on-site or within one-day shipment to avoid delays in the field schedule.

B12.2 Laboratory Instruments

As part of its QA/QC Program, a routine preventative maintenance program is conducted by STL Quanterra to minimize the occurrence of instrument failure and other system malfunctions. STL Quanterra designates an internal group to perform routine scheduled maintenance and to repair, or to coordinate with the vendor for the

repair of, all instruments. All laboratory instruments are maintained in accordance with manufacturers' specifications and the requirements of the specific method employed. This maintenance is carried out on a regular, scheduled basis and is documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided under a repair and maintenance contract with factory representatives. Routine preventative maintenance is completed by the laboratory in a manner consistent with USEPA guidelines, where applicable.

B13. Data Precision And Accuracy Procedures

This section describes specific routine procedures used to assess the precision and the accuracy of the data.

B13.1 Field Measurements

Field data will be assessed by the ARCADIS Geraghty & Miller Field Team Leader and by field team individuals responsible for using the field instruments. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration checks and field analysis of blanks, where warranted. Precision will be assessed on the basis of reproducibility by multiple readings for a single sample.

B13.2 Laboratory Data

Laboratory results will be assessed by the laboratory for compliance with required precision, accuracy, completeness and sensitivity, as discussed in the following sections.

B13.2.1 Precision

Precision of laboratory analysis may be assessed by comparing the analytical results between the MS/MSD pairs for organic analysis and laboratory duplicate analyses for inorganic analysis. The relative percent difference (%RPD) will be calculated for each pair of duplicate analysis using Equation 13-1.

$$\%RPD = \frac{S-D}{(S+D)/2} \times 100 \text{ Eq 13-1}$$

Where: S = First sample value (original or MS value).

D = Second sample value (duplicate or MSD value).

Specific limits for the (%RPDs) are set in the individual methods used for analysis and are either compound and/or matrix specific.

B13.2.2 Accuracy

Accuracy of laboratory results may be assessed for compliance with the established QA/QC criteria that are described in the Quality Assurance Objectives section of this FSQAP (Section 4.0), using the analytical results of method blanks, reagent blanks, MS/MSD samples, field blanks and/or bottle blanks. The percent recovery (%R) of matrix spike samples will be calculated using Equation 13-2.

$$\%R = \frac{A - B}{C} \times 100 \text{ Equ. 13-2.}$$

Where: A = The analyte concentration determined experimentally from the spiked sample.

B = The background level determined by a separate analysis of the unspiked sample.

C = The amount of the spike added.

Specific limits for the %Rs are set in the individual methods used for analysis and are either compound and/or matrix specific.

B13.2.3 Sensitivity

The achievement of method detection limits depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrumental sensitivity to maintain data quality through constant instrument performance. The instrumental sensitivity will be monitored by the laboratory through the analysis of method blanks, calibration check samples and laboratory control samples.

B13.2.2 Accuracy

Accuracy of laboratory results may be assessed for compliance with the established QA/QC criteria that are described in the Quality Assurance Objectives section of this FSQAP (Section 4.0), using the analytical results of method blanks, reagent blanks, MS/MSD samples, field blanks and/or bottle blanks. The percent recovery (%R) of matrix spike samples will be calculated using Equation 13-2.

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B13.2.3 Sensitivity

The achievement of method detection limits depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrumental sensitivity to maintain data quality through constant instrument performance. The instrumental sensitivity will be monitored by the laboratory through the analysis of method blanks, calibration check samples and laboratory control samples.

B14. Corrective Actions

Corrective actions may be required for two classes of problems: (i) analytical and equipment problems; and (ii) non-compliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrument analyses and/or data review.

For non-compliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying Field Team Leader and/or Project Manager. Implementation of corrective action will be confirmed through the same channels. Non-conformance with the established quality control procedures in this FSQAP will be identified and corrected.

Corrective actions will be implemented and documented in the field book. No staff member will initiate corrective action without prior communication of findings through the proper channels (see the organization chart on Figure B3-1).

B14.1 Sample Collection/Field Measurements

Technical staff and project personnel will be responsible for reporting all suspected technical or QA non-conformances, or suspected deficiencies of any activity or issued document by reporting the situation to the Field Team Leader or designee. The Field Team Leader will be responsible for assessing the suspected problems in consultation with the Project Manager to make a decision based on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, appropriate action will be initiated by the Field Team Leader.

The Field Team Leader will be responsible for ensuring that corrective action for non-conformances are initiated by:

- Evaluating all reported non-conformances.
- Controlling additional work on non-conforming items.
- Determining the action to be taken.
- Maintaining a calendar log of non-conformance events and solutions implemented.

- Ensuring descriptions of non-conformance and correlating corrective actions are included in the final site documentation in project files.

If appropriate, the Field Team Leader and Project Manager will ensure that no additional work that depends on the non-conforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- Repeating the measurement to check the error.
- Checking for all proper adjustments for ambient conditions such as temperature.
- Checking the batteries.
- Recalibrating instruments.
- Checking the calibration.
- Repairing or replacing the instrument or measurement devices.
- Stopping work, if necessary, until corrective actions can be implemented and return to appropriate data quality objectives can be confirmed.

The Field Team Leader or designee is responsible for all on-site activities. In this role, the ARCADIS Geraghty & Miller Project Manager at times is required to adjust the field programs and procedures to accommodate Site-specific needs. When it becomes necessary to modify a program, the responsible person will notify the Project Manager or Field Team Leader of the anticipated change and implement the necessary changes after obtaining the approval of the Project Manager. The change in the program will be documented in the field book. The ARCADIS Geraghty & Miller Project Manager must approve the change in writing prior to field implementation, if feasible, or else verbally, with written documentation to follow. In addition, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices.

The ARCADIS Geraghty & Miller Project Manager is also responsible for the controlling, tracking and implementation of the identified changes and will regularly inform the Project Coordinator of any deviations and corrections made.

B14.2 Laboratory Analyses

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is dependent on the analysis and the event.

Laboratory corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy.
- Blanks contain target analytes above acceptable levels.
- Undesirable trends are detected in spike recoveries or %RPD between duplicates.
- There are unusual changes in detection limits (for example, as the result of sample dilutions due to higher-than-anticipated constituent concentrations).
- Deficiencies are detected during internal or external audits or from the results of PE samples.
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors and checks the instrument calibration, spike and calibration mixes and sensitivity. If the problem persists or cannot be identified, the matter is referred to the Laboratory Supervisor, Project Manager and/or QAU for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QAU.

B15. Quality Assurance Reports To Management

The laboratory and or field project records will contain a description of the following QA items (if applicable):

- Changes in this FSQAP.
- Results of performance evaluation audits.
- Significant QA/QC problems, recommended solutions, and results of corrective actions.
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability and conformance with method detection limits and/or estimated quantitation limits.
- Indication of whether the QA objectives were met.
- Limitations on use of the measurement data.

The ARCADIS Geraghty & Miller Project Coordinator will review, and is responsible for, the QA/QC of the Pre-Design Studies investigation report.

16. References

United States Environmental Protection Agency (USEPA), 1985. "NEIC Policies and Procedures." EPA-330/9-78DDI-R. Revised June.

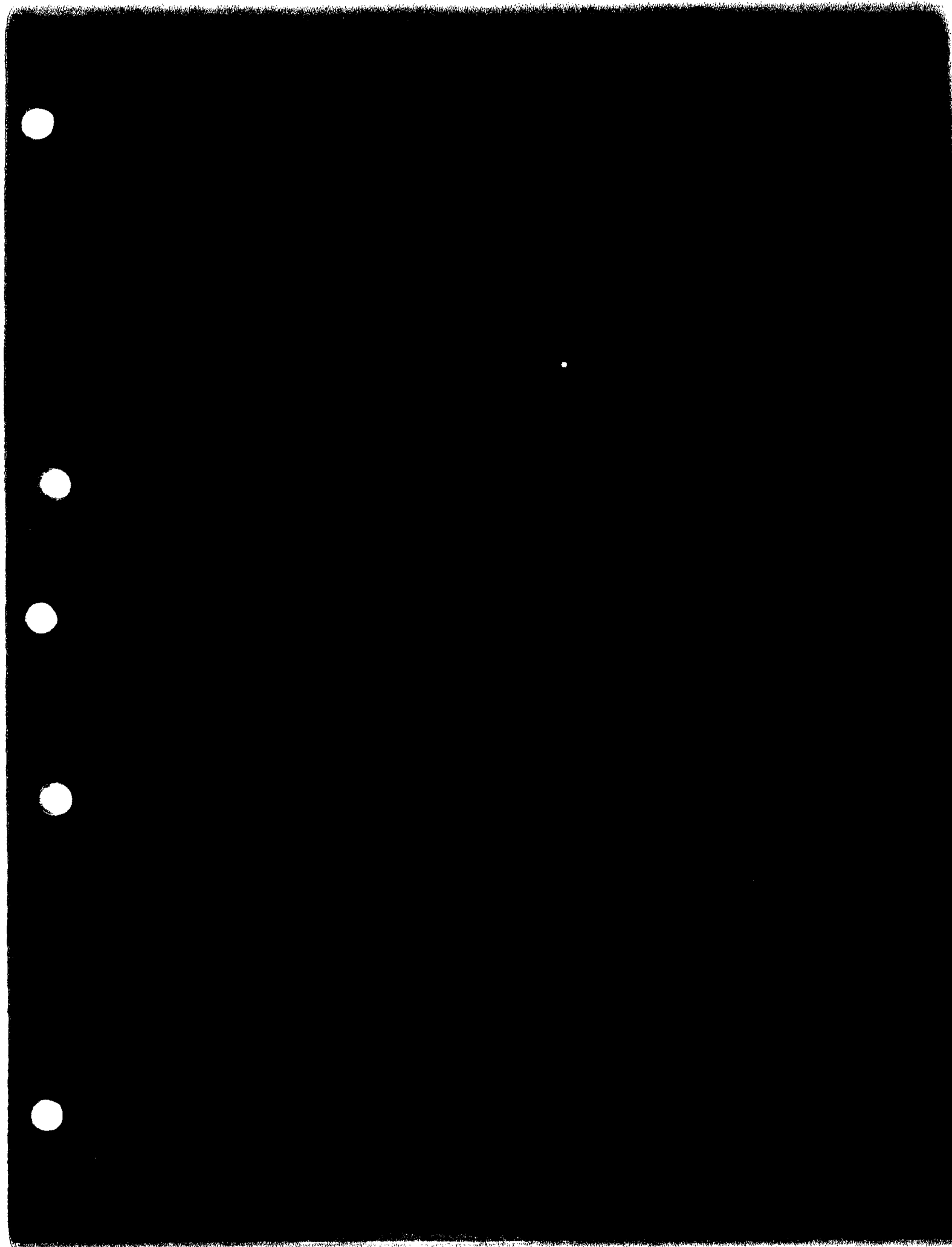
United States Environmental Protection Agency, 1991a. "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" QAMS-005/80.

United States Environmental Protection Agency, 1991b. "Quality Assurance/Quality Control Guidance for Removal Activities." OSWER 9360.4-0-01.

United States Environmental Protection Agency, 1991c. "Region 5 Model QAPjP."

United States Environmental Protection Agency, 1992. "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers." OSWER Directive 9240.0-05A. April.

United States Environmental Protection Agency, 1998. "Declaration of the Selected Remedial Alternative for the North Bronson Industrial Site, Operable Unit 1, City of Bronson, Branch County, Michigan." William E. Muno, Director, Superfund Division. June.



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Table B2-1. Summary of the Laboratory Sampling and Analysis Program, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Sample Matrix | Laboratory Parameters | Data Quality Objective (DQO) (1) | Number of Samples | Number of Field Replicates | Number of Equipment Blanks (2) | Number of Trip Blanks (2) | Matrix Spike* and Matrix Spike Duplicate |
|---|---------------------------|----------------------------------|-------------------|----------------------------|--------------------------------|---------------------------|--|
| SUBSURFACE SOIL (10 soil borings for waste identification) | TAL Metals | 3 | 20 | 0 | 2 | 2 | 0 |
| | Cyanide | 3 | 20 | 0 | 2 | 2 | 0 |
| SEDIMENT (10 samples from County Drain #30) | TAL Metals | 3 | 10 | 0 | 1 | 1 | 0 |
| | Cyanide | 3 | 10 | 0 | 1 | 1 | 0 |
| | PAHs | 3 | 10 | 0 | 1 | 1 | 0 |
| GROUNDWATER (36 monitoring wells; 11 new wells, 25 existing wells) | TCL VOCs | 3 | 33 | 4 | 2 | 3 - 5 | 2 |
| | TAL Metals | 3 | 33 | 4 | 2 | 0 | 2 |
| | Cyanide | 3 | 33 | 4 | 2 | 0 | 2 |
| | Nitrate | 3 | 33 | 4 | 2 | 0 | 2 |
| | Nitrite | 3 | 33 | 4 | 2 | 0 | 2 |
| | BOD | 3 | 8 | 1 | 0 | 0 | 2 |
| | COD | 3 | 8 | 1 | 0 | 0 | 2 |
| | TOC | 3 | 8 | 1 | 0 | 0 | 2 |
| | Alkalinity | 3 | 8 | 1 | 0 | 0 | 2 |
| | Bicarbonate Alkalinity | 3 | 8 | 1 | 0 | 0 | 2 |
| | Sulfate | 3 | 8 | 1 | 0 | 0 | 2 |
| | Nitrogen (Ammonia) | 3 | 8 | 1 | 0 | 0 | 2 |
| | Nitrogen (total Kjeldahl) | 3 | 8 | 1 | 0 | 0 | 2 |
| | Dissolved Mn | 3 | 8 | 1 | 0 | 0 | 2 |
| | Dissolved Fe | 3 | 8 | 1 | 0 | 0 | 2 |
| | Total phosphorus | 3 | 8 | 1 | 0 | 0 | 2 |
| | Orthophosphate | 3 | 8 | 1 | 0 | 0 | 2 |
| | Chloride | 3 | 8 | 1 | 0 | 0 | 2 |
| | Hardness | 3 | 8 | 1 | 0 | 0 | 2 |

Footnotes on Page 2.

Table B2-1. Summary of the Laboratory Sampling and Analysis Program, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| | | |
|--|---|--|
| * (1) (2) TAL TCL VOCs TOC PAHs BOD COD Mn Fe | Matrix spike and matrix spike duplicates will be performed on subsurface soil samples, however additional sample volume need not be collected for these analyses. | |
| | Data quality objectives are defined in Section B2.5. | |
| | per day. At a minimum one blank will be prepared each day. | |
| | Target Analyte List. | |
| | Target Compound List. | |
| | Volatile Organic Compounds. | |
| | Total Organic Carbon. | |
| | Polynuclear Aromatic Hydrocarbons. | |
| | Biochemical Oxygen Demand. | |
| | Chemical Oxygen Demand. | |
| | Manganese. | |
| | Iron. | |

Table B2-2. Analytical Parameters, Analytical Methods, and Practical Quantitation Limits, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Parameter | Method Reference | Practical Quantitation Limits* | |
|---------------------------|---------------------|--------------------------------|-----------------|
| | | Groundwater (µg/L) | Soil (µg/kg) |
| VOCs | | | |
| 1,1,1-Trichloroethane | 8260B | 1 | NA |
| 1,1,2,2-Tetrachloroethane | 8260B | 1 | NA |
| 1,1,2-Trichloroethane | 8260B | 1 | NA |
| 1,1-Dichloroethane | 8260B | 1 | NA |
| 1,2-Dichloroethane | 8260B | 1 | NA |
| 1,1-Dichloroethene | 8260B | 1 | NA |
| cis-1,2-Dichloroethene | 8260B | 0.5 | NA |
| trans-1,2-Dichloroethene | 8260B | 0.5 | NA |
| 1,2-Dichloropropane | 8260B | 1 | NA |
| cis-1,3-Dichloropropene | 8260B | 1 | NA |
| trans-1,3-Dichloropropene | 8260B | 1 | NA |
| 2-Butanone | 8260B | 10 | NA |
| 2-Hexanone | 8260B | 10 | NA |
| 4-Methyl-2-Pentanone | 8260B | 10 | NA |
| Acetone | 8260B | 10 | NA |
| Benzene | 8260B | 1 | NA |
| Bromodichloromethane | 8260B | 1 | NA |
| Bromoform | 8260B | 1 | NA |
| Bromomethane | 8260B | 2 | NA |
| Carbon Disulfide | 8260B | 1 | NA |
| Carbon Tetrachloride | 8260B | 1 | NA |
| Chlorobenzene | 8260B | 1 | NA |
| Chloroethane | 8260B | 2 | NA |
| Chloroform | 8260B | 1 | NA |
| Chloromethane | 8260B | 2 | NA |
| Dibromochloromethane | 8260B | 1 | NA |
| Ethylbenzene | 8260B | 1 | NA |
| Methylene Chloride | 8260B | 1 | NA |
| Styrene | 8260B | 1 | NA |
| Tetrachloroethene | 8260B | 1 | NA |
| Toluene | 8260B | 1 | NA |
| Trichloroethene | 8260B | 2 | NA |
| Vinyl Chloride | 8260B | 2 | NA |
| Xylenes (total) | 8260B | 1 | NA |

Footnotes on Page 3.

Table B2-2. Analytical Parameters, Analytical Methods, and Practical Quantitation Limits, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Parameter | Method Reference | Practical Quantitation Limits* | |
|------------------------|---------------------|--------------------------------|--------------------------|
| | | Groundwater (µg/L) | Soil/Sediment (µg/kg) |
| <u>PAHs</u> | | | |
| 1-Methylnaphthalene | 8270C | NA | 330 |
| 2-Methylnaphthalene | 8270C | NA | 330 |
| Acenaphthene | 8270C | NA | 330 |
| Acenaphthylene | 8270C | NA | 330 |
| Anthracene | 8270C | NA | 330 |
| Benzo(a)anthracene | 8270C | NA | 330 |
| Benzo(a)pyrene | 8270C | NA | 330 |
| Benzo(b)fluoranthene | 8270C | NA | 330 |
| Benzo(ghi)perylene | 8270C | NA | 330 |
| Benzo(k)fluoranthene | 8270C | NA | 330 |
| Chrysene | 8270C | NA | 330 |
| Dibenzo(a,h)anthracene | 8270C | NA | 330 |
| Fluoranthene | 8270C | NA | 330 |
| Flourene | 8270C | NA | 330 |
| Indeno(1,2,3-cd)pyrene | 8270C | NA | 330 |
| Naphthalene | 8270C | NA | 330 |
| Phenanthrene | 8270C | NA | 330 |
| Pyrene | 8270C | NA | 330 |
| Cyanide, total | 9012A | 10 | 500 |

| Parameter | Method Reference | Practical Quantitation Limits* | |
|-------------------|---------------------|--------------------------------|--------------------------|
| | | Groundwater (µg/L) | Soil/Sediment (mg/kg) |
| <u>TAL Metals</u> | | | |
| Aluminum | 6010B | 200 | 20 |
| Barium | 6010B | 200 | 20 |
| Beryllium | 6010B | 5 | 0.5 |
| Calcium | 6010B | 5000 | 500 |
| Cobalt | 6010B | 50 | 5 |
| Chromium | 6010B | 10 | 1 |
| Copper | 6010B | 25 | 2.5 |
| Iron | 6010B | 100 | 10 |
| Potassium | 6010B | 5000 | 500 |
| Magnesium | 6010B | 5000 | 500 |
| Manganese | 6010B | 15 | 1.5 |
| Sodium | 6010B | 5000 | 500 |
| Nickel | 6010B | 40 | 4 |
| Vanadium | 6010B | 50 | 5 |
| Zinc | 6010B | 20 | 2 |

Table B2-2. Analytical Parameters, Analytical Methods, and Practical Quantitation Limits, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| | | | |
|--------|-------|----|---|
| Silver | 6010B | 10 | 1 |
|--------|-------|----|---|

Footnotes on Page 3.

| Parameter | Method Reference | Practical Quantitation Limits* | |
|-----------|------------------|--------------------------------|-----------------------|
| | | Groundwater (µg/L) | Soil/Sediment (mg/kg) |

TAL Metals (continued)

| | | | |
|----------|------------------------|-----|-----|
| Lead | 6010B | 3 | 0.3 |
| Antimony | 6010B | 60 | 6 |
| Selenium | 6010B | 5 | 0.5 |
| Arsenic | 6010B | 10 | 1 |
| Cadmium | 6010B | 5 | 0.5 |
| Thallium | 6010B | 10 | 1 |
| Mercury | 7470A water/7471A soil | 0.2 | 0.1 |

| Parameter | Method Reference | Practical Quantitation Limits* | |
|-----------|------------------|--------------------------------|-----------------------|
| | | Groundwater (µg/L) | Soil/Sediment (µg/kg) |

Parameters to design provisional wetland treatment system.

STL(Quanterra)

| | | | |
|---------------------------|--------|-------|----|
| TOC (water) | 415.1 | 1000 | NA |
| Alkalinity | 310.1 | 5000 | NA |
| Bicarbonate Alkalinity | 310.1 | 5000 | NA |
| Sulfate | 300.0A | 1000 | NA |
| Nitrate | 353.2 | 100 | NA |
| Nitrite | 353.2 | 100 | NA |
| Nitrogen (Ammonia) | 350.3 | 200 | NA |
| Nitrogen (total Kjeldahl) | 351.3 | 1000 | NA |
| Chloride | 300.0A | 1000 | NA |
| BOD | 405.1 | 2000 | NA |
| COD | 410.4 | 10000 | NA |
| Total Phosphorous | 365.2 | 100 | NA |
| Orthophosphate | 300.0A | 500 | NA |
| Hardness | 130.2 | 5000 | NA |

| | |
|-------|---|
| VOCs | Volatile Organic Compounds. |
| PAHs | Polynuclear Aromatic Hydrocarbons |
| TOC | Total Organic Carbon. |
| NA | Not applicable to the Pre-Design Studies scope of work. |
| * | Practical quantitation limits per Severn Trent Laboratories (STL) (formerly Quanterra) SOPs |
| BOD | Biological Oxygen Demand. |
| COD | Chemical Oxygen Demand. |
| µg/L | Micrograms per liter. |
| µg/kg | Micrograms per kilogram. |
| mg/kg | Milligram per kilogram. |

Table B2-3. Summary of Field Measurement Program, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Activity | Field Measurement | Data Quality Objective ⁽¹⁾ |
|-------------------------------------|-----------------------------------|---------------------------------------|
| Subsurface Soil Sampling | Organic Vapor Analyzer Screening, | 1 |
| Surface Soil Sampling | Organic Vapor Analyzer Screening | 1 |
| Groundwater Well Installation | Organic Vapor Analyzer Screening | 1 |
| Groundwater Sample Characterization | Temperature | 1 |
| | pH | 1 |
| | Specific Conductance | 1 |
| | Dissolved Oxygen | 1 |
| | Redox Potential | 1 |
| | Static Water Level | 1 |

(1) Data quality objectives are defined in Section 2.5.

Table B5-1. Summary of Sample Container Requirements*, Preservatives, and Holding Times, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Parameter | Sample Containers | Chemical Preservative | Holding Time |
|------------------------|--------------------------------------|--|---|
| SOIL/SLUDGE** | | | |
| TAL Metals | 1) 2 oz glass jar | None | 6 months/mercury 28 days |
| Cyanide | 1) 2 oz glass jar | None | 14 days |
| SEDIMENT** | | | |
| TAL Metals | 1) 2 oz glass jar | None | 6 months/mercury 28 days |
| Cyanide | 1) 2 oz glass jar | None | 14 days |
| PAHs | 1) 4 oz glass jar | None | 14 days extraction/40 days after CALCULATION |
| WATER** | | | |
| TCL VOCs | 2) 40 ml glass vial | HCL to pH < 2 (no headspace) | 14 days |
| TAL Metals | 1) 1L poly plastic | HNO ₃ to pH < 2 | 6 months; mercury 28 days |
| Nitrate/Nitrite | 1) 250 ml plastic | H ₂ SO ₄ | 28 days |
| Cyanide | 1) 250 ml plastic | NaOH | 14 days |
| TOC | 1) 100 ml plastic or glass bottle | H ₂ SO ₄ to pH < 2 | 28 days |
| Alkalinity | 1) 250 ml plastic or glass bottle | None | 14 days |
| Bicarbonate Alkalinity | 1) 250 ml plastic | None | 14 days |

Footnotes on Page 3.

Table B5-1. Summary of Sample Container Requirements*, Preservatives, and Holding Times, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Parameter | Sample Containers | Chemical Preservative | Holding Time |
|---------------------------|-----------------------------------|---|--------------|
| Sulfate | 1) 100 ml plastic or glass bottle | None | 28 days |
| Nitrate | 1) 250 ml plastic or glass bottle | H ₂ SO ₄ to pH <2 | 28 days |
| Nitrite | 1) 250 ml plastic or glass bottle | H ₂ SO ₄ to pH <2 | 28 days |
| Nitrogen (Ammonia) | 1) 500 ml plastic or glass bottle | H ₂ SO ₄ to pH <2 | 28 days |
| Nitrogen (total Kjeldahl) | 1) 1 Liter plastic | H ₂ SO ₄ to pH <2 | 28 days |
| COD | 1) 250 ml plastic or glass bottle | H ₂ SO ₄ to pH <2 | 28 days |
| BOD | 1) 500 ml plastic | None | 48 hours |
| Chloride | 1) 250 ml plastic or glass bottle | None | 28 days |
| Total Phosphorus | 1) 250 ml plastic | H ₂ SO ₄ to pH <2 | 28 days |
| Orthophosphate | 1) 250 ml plastic | None | 48 hours |
| Hardness | 1) 250 ml plastic | HNO ₃ | 6 months |

Footnotes on Page 3.

Table B5-1. Summary of Sample Container Requirements*, Preservatives, and Holding Times, Operable Unit 1, North Bronson Industrial Area Site, Bronson, Michigan.

| Parameter | Sample Containers | Chemical Preservative | Holding Time |
|--|-----------------------------------|-----------------------|--------------|
| Dissolved Mn | 1) 500 ml plastic | HNO ₃ | 6 months |
| Dissolved Fe | 1) 500 ml plastic | HNO ₃ | 6 months |
| * Container requirements are those required for a particular analyses. Fewer containers may be required as more than one analysis may be obtained from a container. Specific container requirements will be determined by the laboratory and conveyed to the field sampling personnel. | | | |
| ** All samples shall be cooled to 4°C. | | | |
| VOCs | Volatile Organic Compounds. | | |
| PAHs | Polynuclear Aromatic Hydrocarbons | | |
| TOC | Total Organic Carbon. | | |
| COD | Chemical Oxygen Demand. | | |
| BOD | Biochemical Oxygen Demand. | | |
| TAL | Target Analyte List | | |
| TCL | Target Compound List | | |
| HCL | Hydrochloride acid. | | |
| HNO ₃ | Nitric acid. | | |
| H ₂ SO ₄ | Sulfuric acid. | | |
| NaOH | Sodium Hydroxide | | |
| Mn | Manganese | | |
| Fe | Iron | | |



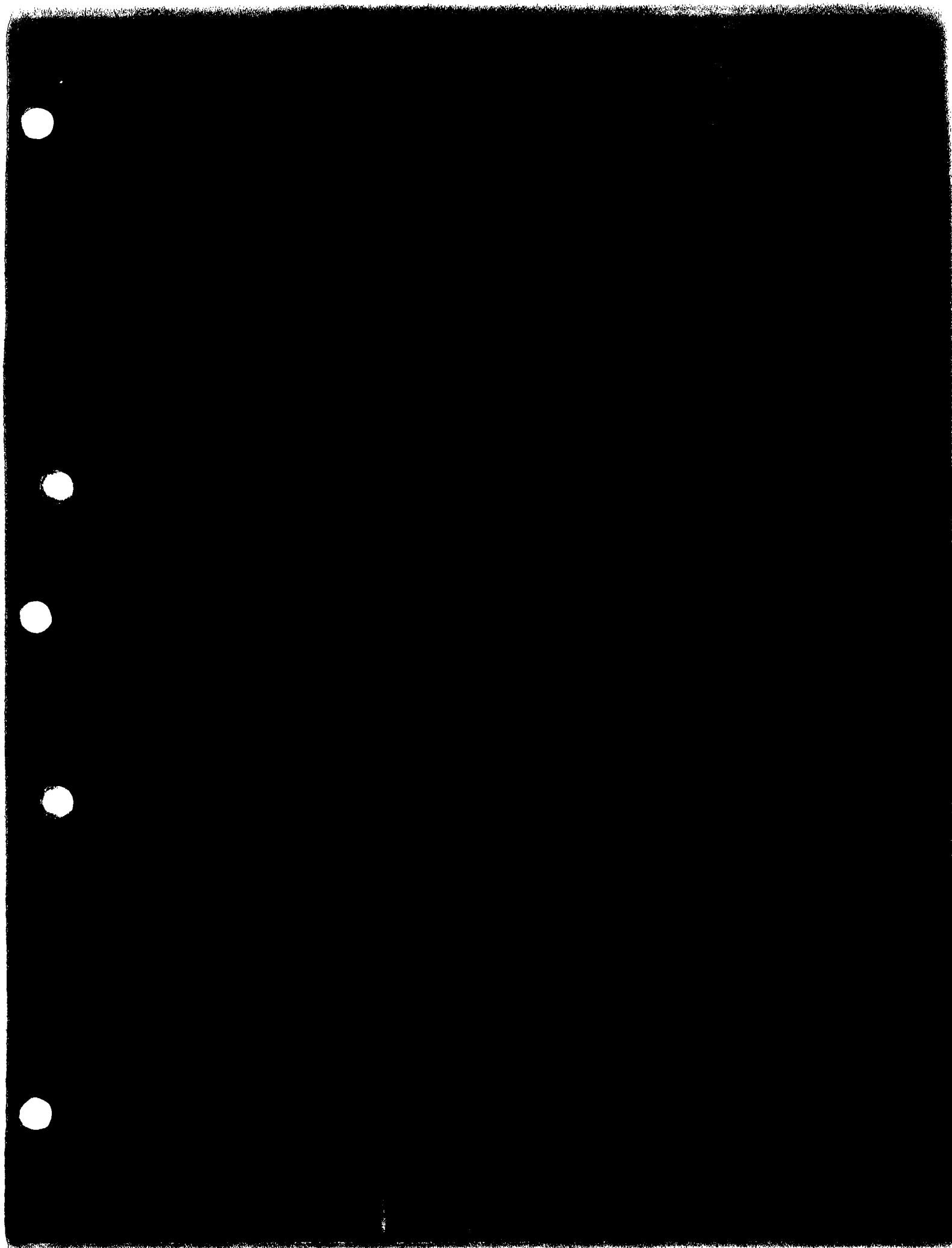
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C

**Attachment A
Equipment Standard Operating Procedures**

EQUIPMENT SOP

SOP #1 - PH METER STANDARD OPERATING PROCEDURES

The pH measures the concentration of the hydrogen ion in a solution. A pH value of 7 is neutral, while pH values less than 7 indicate an acidic solution. Values greater than 7 are basic.

Equipment:

- ___ pH meter/temp probe
- ___ Standard solutions (4, 7, 10)

Procedures:

1. Pour sample into clean beaker
2. Rinse thermometer or temperature probe with distilled water and place in sample.
3. Remove cap from pH probe and rinse with distilled water.
4. Place probes in sample and allow to stabilize (10-20 seconds).
5. Take a pH and temperature reading. Reading must be within the two-point calibration or the meter must be recalibrated using a different standard solution (See pH meter calibration procedures).
6. Rinse probes with distilled water

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7. Repeat the above two steps two times to collect a dual measurement of pH at its respective temperature.
8. Fill cap with distilled water and place on end of probe.

pH Meter Calibration:

Equipment:

- ___ pH standards (4, 7, and 10)
- ___ Distilled water
- ___ Thermometer

Note: pH standards and distilled water should be stored in similar locations so temperature is the same.

Procedures:

1. Remove cap from pH probe and rinse it along with the thermometer (or temperature probe) with distilled water.
2. Place pH probe and thermometer (or temperature probe) in pH 7 standard solution and allow to stabilize for 10 to 20 seconds. Push the "CAL" button on the meter.
3. Remove pH probes from solution and rinse with distilled water.
4. Place pH probe and thermometer (or temperature probe) in pH 4 or 10 standard solution and allow to stabilize for several seconds. Push the "CON" button. Note: Use the sample to determine which standard to use. If sample has a pH value less than 7, use 4 solution. If sample has a pH value greater than 7, use 10 solution. This allows the slope of the meter to be consistent with characteristics of the sample.

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5. Remove pH probe and thermometer (or temperature probe) from solution and rinse with distilled water.
6. Place pH probe and thermometer (or temperature probe) in pH 7 standard solution again and allow to stabilize. Take a reading. Repeat for standard 4 or 10. Each reading must be within ± 0.1 of the standard solution.
7. Fill cap for pH probe with distilled water (to keep probe moist) and place it on probe.

QA/QC Requirements:

pH meter calibration should be checked with a 7-standard solution every four hours. If reading is greater than ± 0.1 of standard, repeat calibration process.

Standard solutions should be replaced every 6 months.

One replicate pH measurement per every five investigative measurements or one per day, whichever is greater, must be made.

SOP #2 - SPECIFIC CONDUCTIVITY METER STANDARD OPERATING PROCEDURES

Equipment:

- ___ Specific conductivity meter
- ___ Standard solution (1413 mmhos/cm)
- ___ Paperwork

The specific conductivity of a substance refers to its ability to conduct an electric current. This value provides a measure of the concentration of dissolved solids in water samples.

Procedures:

1. Pour sample into clean beaker.
2. Rinse probe with distilled water.
3. Insert conductivity probe into sample and allow it to stabilize for 10 to 20 seconds. The probe automatically adjusts for temperature.
4. Take a reading and record on Sampling Log.
5. Rinse probe with distilled water.
6. Repeat the above two steps two times to collect a dual measurement of specific conductance.

Specific Conductivity Meter Calibration:

Equipment:

- ___ Conductivity Standard (1413 mmhos/cm)
- ___ Distilled water

Conductivity standards and distilled water should be stored in similar locations so temperature is the same.

Procedures:

1. Rinse conductivity probe with distilled water.
2. Place probe in 1413 standard and allow to stabilize for 10 to 20 seconds.
3. Take reading. If necessary, adjust calibrations screw to ± 10 mmhos/cm (probe automatically adjusts for temperature). Record value on Specific Conductivity Meter Calibration Log and Water Sampling Log (if applicable).
4. Rinse probe with distilled water.

QA/QC Requirements:

Specific conductivity calibration should be checked every four hours. If reading is greater than ± 10 mmhos/cm of standard, repeat calibration.

Standard solutions should be replaced every nine months per manufacturer recommendations.

One replicate specific conductance measurement set should be made per every five investigative measurements or every day, whichever is greater.

SOP # 3 - YSI 600 XL MULTI-PARAMETER WATER QUALITY MONITOR

D.O. and Redox

Equipment:

- _____ YSI 600 XL Multi-Parameter Water Quality Monitor.
- _____ Field cable.
- _____ YSI 610D Display or YSI 610DM Display and Logger.
- _____ Standard Solutions.

Procedures:

A. Field Operations:

When you have calibrated the sensors, enabled the sensors as you prefer, and have set up the report to show the parameters you want to see, you are then ready to take readings.

1. Place the 600XL within water of concern.
2. Select 1. Run from the sonde Main menu.
3. Select 2. Sample interval.
4. Input a number which represents the number of SECONDS between samples.
5. Next, Select 1. Start sampling from the Run setup menu.

6. Measurements will begin to appear on the screen at the sampling interval you have defined. This data will not be stored to a file unless you instruct PC 6000 to capture this data. To create a file of the information which is displayed on your computer PC6000 system – press F3 as instructed at the bottom of the display screen. See section 3.4 Data Capture.

B. Instrument Daily Calibration - Redox

1. Select option ISE2-Orp to calibrate the ORP sensor.
2. Immerse the sonde in a solution with a know oxidation reduction potential value (Zobell solution recommended) and press Enter. You will be prompted to enter the ORP value of the solution.
3. Press Enter, and monitor the stabilization of the ORP and temperature readings.
4. After no changes occur for approximately 30 seconds, press Enter to confirm the calibration.
5. As instructed, press Enter again to return to the Calibrate menu.

C. Instrument Calibration Check - Redox

Redox Instrument Calibration check.

1. To determine whether the sensor is functioning correctly, place the ORP probe in 3682 Zobell solution and monitor the millivolt reading.
2. If the probe is functioning within specifications, the ORP reading should be within the range of 221-241 at normal ambient temperature. If the reading is outside of this range, the probe can be calibrated to the correct value (229 mV at 25° C) using the calibration procedure outlined earlier.

3. ORP readings for the same solution can vary up to 100 mv depending on the temperature. However, no standard compensation algorithms exist for this parameter. Be sure to take this factor into account when reporting ORP values.

D. Instrument Daily Calibration - Dissolved Oxygen

1. Select the Dissolved Oxygen option to calibrate the oxygen probe, the submenu will offer you the option of calibrating in percent saturation or mg/L.
2. After selecting the option of choice (water-saturated air is normally recommended), you will be prompted for the next step. Calibrating either of the choices will automatically calibrate the other.
3. For the percent saturation mode, be certain that the sensor has been thermally equilibrated in water-saturated air and that the sensor has stabilized (about 10-15 minutes) prior to beginning the calibration routine, particularly after a membrane change.
4. Relieve pressure in the cup if necessary.
5. Follow the screen prompt and enter the local barometric pressure in mm Hg, (in Hg x 25.4), press Enter, and monitor the stabilization of the DO readings.
6. After no changes occur for approximately 30 seconds, press Enter to confirm the calibration.
7. As instructed, press Enter again to return to the Calibrate menu.
8. For the mg/l mode, calibration is carried out in a water sample which has a known concentration of dissolved oxygen, usually determined by a Winkler titration. For this calibration procedure, the sensor should be immersed in the water. After thermal equilibration, enter known mg/l value, press Enter, and the calibration procedure will begin with similar viewing of stabilization and confirmation of calibration as for the percent saturation mode above.

Note: Usually the stability of your DO sensor will allow calibration in 2-3 minutes of pulsing during the calibration protocol. However, after a membrane change, a somewhat longer period may be required (approximately 5 minutes). If you have resurfaced your DO sensor, running the probe (either in the Run or Calibrate Mode) for 15-30 minutes is recommended or until good stability is realized.

E. Instrument Calibration Check - Dissolved Oxygen

1. Place approximately 1/8 inch of water or a wet sponge in the bottom of the calibration cup.
2. Place the probe end of the sonde into the calibration cup. Make certain that the DO and the temperature probes are not immersed in the water.
3. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperatures of the thermistor and the oxygen probe to equilibrate.
4. Make certain that the calibration cup is vented to the atmosphere.
5. From the Calibrate menu, select 2. Dissolved Oxy to access the DO% calibration procedure.
6. Enter the current barometric pressure in mm of Hg. Remember that barometer readings which appear in meteorological reports are generally corrected to sea level and are not useful for your calibration procedure unless they are uncorrected.

Note: Inches of Hg x 25.4 mm/inch = mm Hg

7. Press Enter and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
8. Observe the readings under DO% and when they show no significant change for approximately 30 seconds, press Enter.

9. The screen will indicate that the calibration has been accepted and prompt you to press Enter again to return to the Calibrate menu.
10. Rinse the sonde in water and dry the sonde.

Note: Calibration of dissolved oxygen in the DO% procedure also results in calibration of the DO mg/L mode and vice versa.

Note: The above procedures is designed to calibrate your dissolved oxygen sensor for use in sampling applications where the sensor is being pulsed continuously in the Run mode because both “Auto sleep;” and “Wait for DO” functions have been disabled as described in Section 2. If your 600XL is to be used in a monitoring application in which data is being captured to a computer or data collection platform, “Auto sleep” and “Wait for DO” will be activated and the calibration displays will be somewhat different. See Section 4 for details.

SOP #4: FERROUS IRON TEST KIT OPERATING PROCEDURES

Equipment:

_____ 25 mL flask

_____ Reagent powder

_____ Color viewing tubes

_____ Compactor box

Procedures:

Ferrous Iron (Fe^{2+}) Test instructions for IR18, IR18A, or IR18B Test Kits, Test range 0 to 5.00 mg/L.

1. Rinse both color viewing tubes with water to be tested.
2. Rinse a 25-ml flask with water to be tested. Fill the flask to the 25-ml mark with your water sample.
3. Tear open one Ferrous Iron reagent powder pillow for a 25 ml sample (1037-69).
 - A. Add the contents of the pillow to the 25-ml flask, swirl to mix (Do Not Shake).
 - B. Wait 3 minutes for an orange color to develop. Pour off 5 ml from the 25 ml flask into one of the color viewing tubes. Place this tube in the right opening of the color compactor box.
4. Fill the other viewing tube to the 5 ml mark with clear sample water. Place this tube in the left top opening of the color compactor box.
5. Hold the compactor box up to a light source and view through the opening in the front. Rotate the disk to obtain a color match. The range is 0 to 5.00 mg/L.

QA/QC Requirements:

Ferrous iron reagent should be replaced every 12 months.

Store reagents in a dry area.

To check the reagent, test water that contains visible rust. If a color develops the reagent is performing properly. If no color develops, the reagent has deteriorated and should be replaced.

Reagent accuracy should be checked periodically by using a reliable standard.

SOP #5: LANDTEC GA-90 INFRARED GAS ANALYZER (METHANE DETECTOR)

Equipment:

- _____ Landtec GA-90 Infrared Analyzer.
- _____ Calibration Kit (regulators, stand, hose kit, span gas).
- _____ Data Logger Kit (Software and cable).

Procedures:

Field Operations:

1. Connect sample probe to the sample inlet.
2. Turn on the GA90 by pressing the red key.
3. Adjust contrast if necessary.
 - a) Key 1 - increase
 - b) Key 2 - decrease
 - c) Key 0 - exit
4. Main menu appears - press Key 2.
5. Read Gas Levels appears.
6. Connect sample probe to the survey area.
7. Press Key 5 - pump on.
8. A. MANUAL

1. Within 30 seconds the readings will stabilize.
2. Press Key 6 - store the readings.
3. Enter the IDC information:
 - a) Up arrow and down arrows to step.
 - b) Press 0 to enter and accept data.
4. Press 0 to store, returns to read gases.

B. AUTOMATIC

1. Within 30 seconds the readings will stabilize.
2. Press Key 8 - log the readings.
3. Enter the IDC information:
 - a) Up arrow and down arrows to step.
 - b) Press 0 to store the identity code.
4. Enter the required logging interval.
 - a) 5 to 60 minutes.
 - b) Press 0 to exit.
5. Select running time for pump.
 - a) 15, 30, 45, 60, 90 seconds.
 - b) Press 0 to exit.
6. Logging has been initiated.
7. To stop logging, Key 0.

C. INSTRUMENT DAILY CALIBRATION

1. Press red key - turn on.
2. Key 0 - exit.
3. Press Key 1 - General Utilities (Main Menu).
4. Press Key 9 - More.

5. Press Key 5 - Calibration or Press Key 7 - Calibration.
6. Press Key 1 - CH₄ Calibration.

CH₄ - ZERO

1. Press Key 1 - Zero CH₄.
2. Press Key 5 - Turns on the pump for 5 minutes.
3. Press Key 1 - Zero level.
 - a) Message - "CH₄ Zeroed" appears.
 - b) Back to Zero CH₄.
4. Press Key 0 - Exit to CH₄ calibration.

CH₄ - SPAN

1. Press Key 2 - calibrate CH₄ span.
2. Press Key 5 - turns on pump.
3. Apply %VOL CH₄ to the sample port for 2 minutes.
4. Press Key 1 - enter gas concentration.
 - a) Input the CH₄ concentration.
 - b) Press Key 0 - exit.
 - c) "Caution Re-Calibrate Are You Sure?" appears.
 - d) Press Key 1 - yes.
 - e) Message "Calibration OK" appears.
 - f) Back to CH₄ span.
5. Press Key 0 - CH₄ Calibration.
6. Press Key 0 - Calibration.

Note: There is no zero CO₂ function as there is in CH₄ or O₂.

CO₂ SPAN

1. Press Key 2 - CO₂ Calibration.
2. Press Key 5 - turn on pump.
3. Apply % Vol CO₂ to the sample port for 2 minutes.
4. Press Key 1 - enter gas concentration.
 - a) Input the CO₂ concentration.
 - b) Press Key 0 - exit.
 - c) "Caution Re-Calibrate Are You Sure?" appears.
 - d) Press Key 1 - yes.
 - e) Message - "Calibration OK" appears.
 - f) Back to CO₂ Span.
5. Press Key 0 - calibration.

O₂ ZERO

1. Press Key 3 - O₂ Calibration.
2. Press Key 1 - zero O₂
3. Press Key 5 - turns on the pump.
4. Apply N₂ to the sample port for 2 minutes.
 - a) Wait until the reading stabilizes near 0.
5. Press Key 1 - zero level.
 - a) Message - "O₂ Zeroed" appears.
 - b) Back to O₂ Zero.
6. Press Key 0 - exit to O₂ calibration.

D. INSTRUMENT CALIBRATION CHECK

1. Connect sample probe to the sample inlet.
2. Turn on the GA90 by pressing the red key.
3. Key 0 - exit.
4. Main menu appears - press Key 2.
5. "Read Gas Levels" appears.

6. Press Key 5 - pump on.
7. Connect sample probe to the test gases.
8. CH₄.
 - a) Apply CH₄ test gas - test value should read within +/-.
9. CO₂.
 - a) Apply CO₂ test gas - test value should read within +/-.
10. O₂
 - a) Apply fresh air - test value should read between 20 and 21%.

E. SAMPLE MEASUREMENT

1. Before entering a contaminated area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.
2. Take measurements in areas of interest, recording readings and locations.

F. QA/QC REQUIREMENTS:

The instrument must undergo a calibration as described above every morning before commencement of field work. The readings from the GA-90 will be used to screen air gas samples and to monitor the air quality in the breathing zone during sampling or drilling activities.

Reference: Modified from Landfill Control Technologies, Commerce, California, 1994.

SOP #6 - A) HNU PHOTOIONIZATION DETECTOR PROCEDURES

B) OVA FLAME IONIZATION DETECTOR PROCEDURES

Equipment:

- ___ HNu Model P1 101 (10.2 eV lamp)
- ___ OVA Model 128 Foxboro Organic Vapor Analyzer
- ___ Calibrant Gases (HNu-Isobutylene: 20-200 ppm and 0-20 ppm) (OVA-Methane: 100 ppm)
- ___ HNu/OVA Calibration Instruction
- ___ Flow meter

Procedure (A): HNu PID

Instrument Set-Up:

1. Prior to calibration, check the function switch on the control panel to make sure it is in the "OFF" position. The probe nozzle is stored inside the instrument cover. Remove cover plate by pulling up on the pins that fasten the cover plate.
2. Remove the nozzle from the cover. Assemble probe by screwing nozzle into casing.
3. Attach probe cable to instrument box inserting 12 pin interface connector of the probe into the connector on the instrument panel. Match the alignment keys and insert connector. Turn connector in clockwise direction until a distinct snap and lock is felt.
4. Turn the function switch to the Battery Check position. When the battery is charged, the needle should read within or above the green battery arc on the scale plate. If the needle is below the green arc or the red LED light comes on, the instrument should be recharged prior to making any measurements.

5. Turn the function switch to the "ON" position. In this position, the UV light source should be on. To verify, gaze at the end of the probe for a purple glow. Do not look directly at the lamp itself. If the lamp does not come on refer to the Instruction Manual.
6. To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counter clockwise rotation yields a downscale deflection. (Note: No zero gas is needed since this is an electronic zero adjustment.) If the span adjustment is changed during instrument calibrations, the zero should be rechecked and adjusted. If necessary, wait 15 to 20 seconds to ensure that the zero reading is stable. Readjust as necessary.

Instrument Daily Calibration:

1. Insert one end of T tube into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotameter (bubble meter) attached.
2. Set the function switch in the 0-200 ppm range. Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotameter. The instrument will draw in the volume required for detection with the rotameter indicating excess flow.
3. Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder.)
4. Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary following step 6 above.
5. Record on field-data sheet all original and readjusted setting.
6. Set the function switch to 0-20 ppm. Remove the mid-range (20-200 ppm) calibration gas cylinder and attach the low-range (0-20 ppm) calibration gas cylinder as described above.

7. Do not adjust the span potentiometer. The observed reading should be ± 3 ppm of the concentration specified for the low-range calibration gas. If this is not the case, recalibrate the mid-range scale repeating Step 1 through 6 above. If the low-range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. Clean window according to instruction manual. When the observed reading is within the required tolerances, the instrument is fully calibrated.

Instrument Calibration Check:

1. Exit the exclusion zone and turn meter to "ON" position. Check that the meter is reading a value of zero.
2. Insert one end of T-tube into probe and other end into calibration gas. The third end of the T-tube should be attached to a flow meter.
3. Crack the valve on the calibration gas and read the value shown by the instrument. Record the value and calibrant gas concentration in the field notebook.
4. If the value shown by the instrument is greater than $\pm 20\%$ of the calibrant gas concentration, take meter outside of exclusion zone and recalibrate as outlined above.

Sample Measurement:

1. Place function switch in 0-20 ppm range for field monitoring. This will allow for most sensitive, quick response in detecting airborne contaminants.
2. Before entering a potentially contaminated area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.

3. Take measurements in the area of interest recording readings and locations. Should readings exceed the 0-20 scale, switch the function switch to the 0-200 or 0-2,000 range as appropriate to receive a direct reading. Return the instrument switch to the 0-20 range when readings are reduced to that level. Record measurements on field-data sheet.

Note: The instrument will not function properly in high humidity or when the window to the light housing is dirty. If the instrument response is erratic or lower than expected, recalibrate or obtain a different meter and calibrate as outlined above.

4. When finished, reverse Steps 1 through 6 in Instrument Setup section to shut down the instrument.

QA/QC Requirements:

The instrument must undergo a 2-point calibration as described above every morning before commencement of field work. The readings from the HNu or similar device will be used to screen soil and groundwater samples and to monitor air quality in the breathing zone during sampling or drilling activities.

Reference: Modified from TSAI, U.S. EPA Region V, QAS.

Procedure (B): OVA FID

Field Operations:

1. Check battery condition by moving the INSTR Switch to the BATT position.
2. Move PUMP Switch to "ON" position, then place instrument in vertical position and check SAMPLE FLOW RATE indication. The normal range is 1.5 to 2.5 units. If less, check filters.
3. Open the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE. Wait one minute for hydrogen to purge the system.

4. Depress Igniter Button until burner lights. Do not depress Igniter Button for more than six seconds (if burner does not ignite, let hydrogen flow for one minute and again attempt ignition).
5. After ignition, Allow approximately five minutes for instrument warm-up. After warm-up, the meter should display a normal background hydrocarbon concentration between 5 and 10 ppm.
6. To shut down the OVA, perform the following:
 - a) Close the HYDROGEN SUPPLY VALVE
 - b) Close the HYDROGEN TANK VALVE
 - c) Move the INSTR Switch and PUMP Switch to "OFF"
 - d) Instrument is now in the shut down configuration

Instrument Daily Calibration:

1. Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT dial set to 300, and allow 20 minutes for warm up and stabilization.
2. Use the CALIBRATE ADJUST (zero) knob to adjust the meter reading to zero.
3. Introduce a methane sample of a known concentration (100 ppm) and adjust trimpot R32 so the meter reading corresponds to the known sample.
4. Extinguish the flame by blocking the exhaust ports or turning the hydrogen supply and pressure valves off.
5. Leave CALIBRATE Switch on x10 position and use CALIBRATE ADJUST (zero) knob to adjust Readout meter reading to 4 ppm.
6. Move the CALIBRATE Switch to the X1 position and using trimpot R31, adjust Readout meter to 4 ppm.

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7. Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) knob to adjust Readout meter to 40 ppm.
8. Move CALIBRATE Switch X100 position and use trimpot R33 to adjust Readout meter to 4 ppm.
9. Move CALIBRATE Switch back to X10 scale. Rezero Readout meter to 0 ppm.
10. Unit is now balanced over the full range.

Instrument Calibration Check:

1. Once the OVA is operating properly, place the readout scale to the X10 position.
2. Connect the tube of the calibration gas (100 ppm methane) to the end of the probe of the OVA.
3. Open the valve of the calibration gas. Read the concentration on the readout dial. It should read approximately 10 ppm (1 ppm on the X100 scale or 100 ppm on the X1 scale). NOTE: Concentration should be within $\pm 20\%$ of actual concentration.

Sample Measurement:

1. Place the meter scale to the X1 position. This will allow for most sensitive, quick response in detecting airborne contaminants.
2. Before entering a contaminated area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.

3. Take measurements in contaminated area, recording readings and locations. Should readings exceed the X1 position when readings are reduced to that level. Record all measurements on the Health and Safety Log.

NOTE: The instrument will not function properly in extreme cold or hot conditions. If meter readings become erratic, attempt to calibrate or use a different meter.

QA/QC Requirements:

The instrument must undergo a 2-point calibration as described above every morning before commencement of field work. The readings from the OVA will be used to screen soil and groundwater samples and to monitor the air quality in the breathing zone during sampling or drilling activities.

Reference: Modified from TSAI, U.S. EPA Region V, QAS.

ATTACHMENT B

**Equipment Decontamination
Procedures.**

Attachment B Equipment Decontamination Procedures

Decontamination Protocol for Soil Sampling Equipment

- Step 1** Scrub equipment thoroughly with soft-bristled brushes in a solution of laboratory-grade soap and tap water.
- Step 2** Rinse equipment with tap water by submerging and/or spraying.
- Step 3** Rinse equipment with distilled water by spraying until dripping.
- Step 4** Rinse equipment with distilled water a second time by spraying until dripping.
- Step 5** Place equipment or plastic or aluminum foil and allow to air dry for 5 to 10 minutes.

Decontamination Protocol for Monitoring Well Sampling Equipment - Submersible Pumps

- Step 1** After removing the pump from the well, rinse the outside of the pump with a solution of laboratory-grade soap and tap water and scrub with a brush. Spray the solution onto the sampling pump hose using a pressurized sprayer.
- Step 2** Once the detergent rinse is finished, spray the hose with a tap water rinse. Bring the hose to the decontamination station.
- Step 3** At the decontamination station, place the pump into a PVC tube approximately 3 to 4 feet in length, which is filled with detergent-tap water solution. Turn on the pump and let run until approximately 1 to 2 gallons of detergent-tap water solution is pumped through the pump.
- Step 4** Place the pump into a second PVC tube that is filled with tap water. Repeat the procedure described in Step 3 until approximately 1 to 2 gallons of tap water is pumped through the pump.
- Step 5** Place the pump into a third PVC tube that is filled with distilled water. Repeat the procedure described in Step 3 until approximately 1 gallon of distilled water is pumped through the pump. At this time, pump through additional distilled and organic free water for preparation of field blanks, if needed.
- Step 6** Wrap the pump head in aluminum foil until usage.

ATTACHMENT C

Sample Core Log.

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Sample/Core Log

Boring/Well _____ Project/No. _____ Page _____ of _____

| Site | Drilling | Drilling |
|------|----------|----------|
|------|----------|----------|

Location _____ Started _____ Completed _____

Total Depth Drilled _____ Feet Hole Diameter _____ inches Coring Device _____

Length and Diameter of Coring Device _____ Sampling Interval _____ feet

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

| | |
|---------------------|-----------------|
| Drilling Fluid Used | Drilling Method |
|---------------------|-----------------|

Drilling Contractor _____ Driller _____ Helper _____

Prepared By _____ Hammer Weight _____ Hammer Drop _____ ins.

| Sample/Core Depth (feet below land surface) | | Core Recovery (feet) | Time/Hydraulic Pressure or Blows per 6 Inches |
|--|----|----------------------------|--|
| From | To | | |

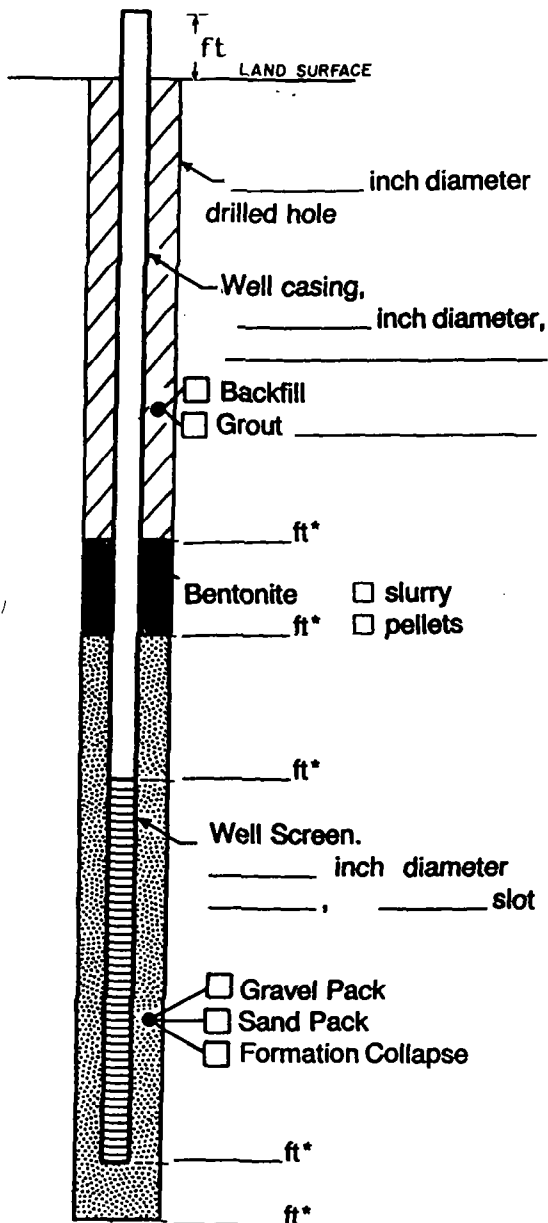
| From | To | (feet) | Inches | Sample/Core Description |
|------|----|--------|--------|-------------------------|
|------|----|--------|--------|-------------------------|

[illegible]

ATTACHMENT D

**Monitoring Well Construction
Detail.**

WELL CONSTRUCTION LOG (UNCONSOLIDATED)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

*Depth Below Land Surface

Project _____ Well _____

Town/City _____

County _____ State _____

Permit No. _____

Land-Surface Elevation _____

and Datum _____ feet ☐ Surveyed

☐ Estimated

Installation Date(s) _____

Drilling Method _____

Drilling Contractor _____

Drilling Fluid _____

Development Technique(s) and Date(s) _____

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose _____

Remarks _____

Prepared by _____

ATTACHMENT E

Water Sampling Log.

WATER SAMPLING LOG

Project/No. _____

Page _____ of _____

Site Location _____

Site/Well No. _____

Coded/
Replicate No. _____

Date _____

Weather _____

Time Sampling
Began _____

Time Sampling
Completed _____

EVACUATION DATA

Description of Measuring Point (MP) _____

Height of MP Above/Below Land Surface _____ MP Elevation _____

Total Sounded Depth of Well Below MP _____ Water-Level Elevation _____

Held _____ Depth to Water Below MP _____ Diameter of Casing _____

Wet _____ Water Column in Well _____ Gallons Pumped/Bailed
Prior to Sampling _____

Gallons per Foot _____

Gallons in Well _____ Sampling Pump Intake Setting
(feet below land surface) _____

Evacuation Method _____

SAMPLING DATA/FIELD PARAMETERS

Color _____ Odor _____ Appearance _____ Temperature _____ °F/°C

Other (specific ion; OVA; HNU; etc.) _____

Specific Conductance,
umhos/cm _____ pH _____

Sampling Method and Material _____

| Constituents Sampled | Container Description From Lab _____ or G&M _____ | Preservative |
|----------------------|--|--------------|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

Remarks _____

Sampling Personnel _____

| WELL CASING VOLUMES | | | | |
|---------------------|---------------|---------------|---------------|-----------|
| GAL./FT. | 1-1/4" = 0.06 | 2" = 0.16 | 3" = 0.37 | 4" = 0.65 |
| | 1-1/2" = 0.09 | 2-1/2" = 0.26 | 3-1/2" = 0.60 | 6" = 1.47 |

